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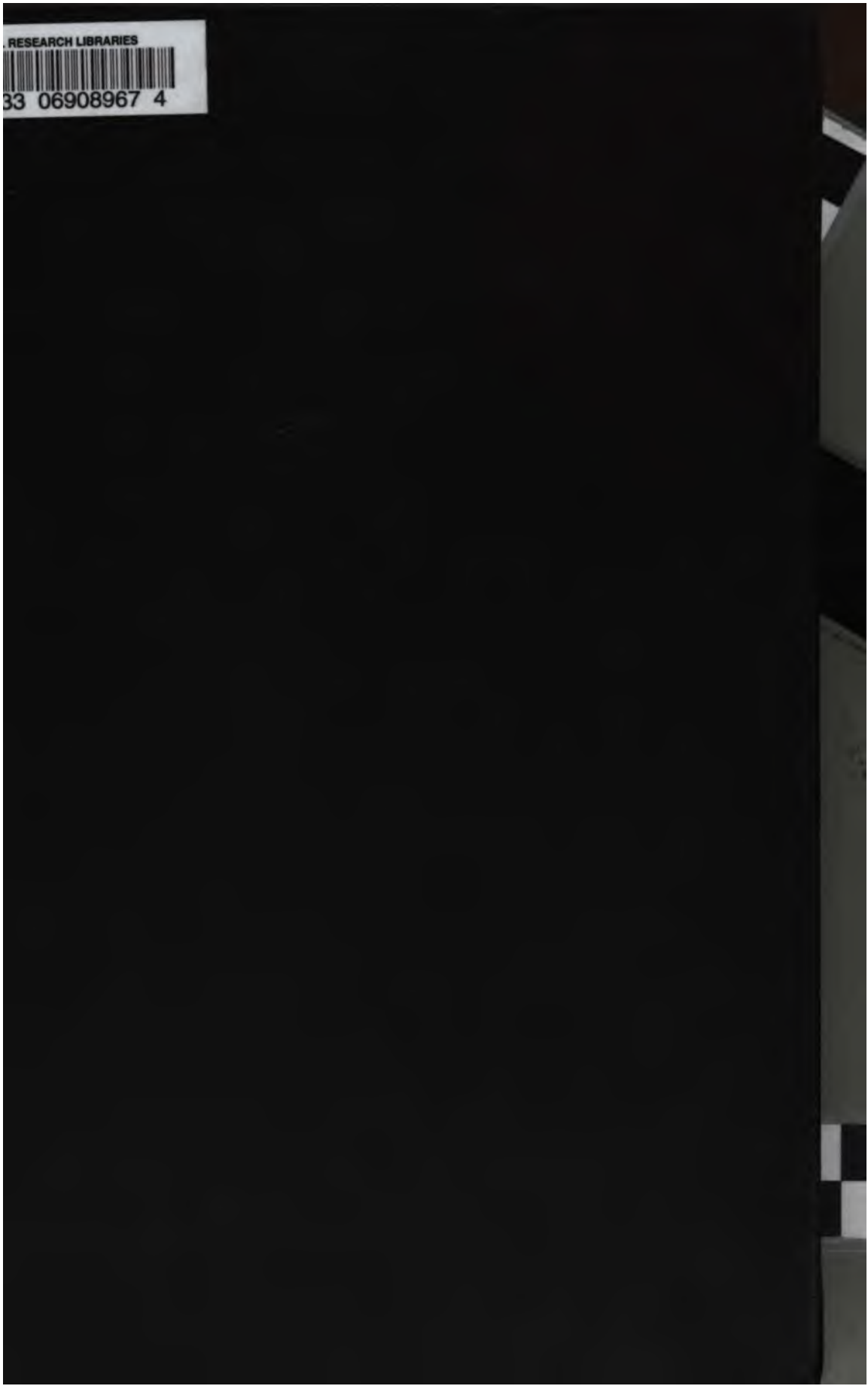
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N. E. COTTON MANUFACTURERS' ASSOCIATION.

PROCEEDINGS

OF THE

FOURTEENTH ANNUAL MEETING,

HELD AT BOSTON APRIL 30, 1879:

PRECEDED BY

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1879.

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Benjamin F. Nourse,	Boston, Mass.

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Phinehas Adams,	Stark Mills,	Manchester, N.H.
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James S. Amory,	Lancaster Mills,	Boston, Mass.
Wm. Amory, Jr.,	Langdon Mills,	Boston, Mass.
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George Atkinson,	Massachusetts Mills,	Boston, Mass.
A. T. Atherton,		Lowell, Mass.
J. S. Atwood,	Wauregan Mills,	Wauregan, Conn.
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A. A. Barker,	Palmer Mills,	Three Rivers, Mass.
A. D. Barker,	Warren Cotton Mills,	West Warren, Mass.
Cyrus I. Barker,	Bates Manuf. Co,	Lewiston, Me.
W. E. Barrows,	Willimantic Linen Co.,	Hartford, Conn.
Stockton Bates,	Bridesburg Manuf. Co.,	Philadelphia, Penn.
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George W. Bean,	Merchants' Mill,	Fall River, Mass.
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Nathan Benton,		Slatersville, R.I.
John Birkenhead,		Mansfield, Mass.
N. B. Borden,	Ballard Manuf. Co.,	Fall River, Mass.
Richard B. Borden,	Troy C. and W. Manuf. Co.,	Fall River, Mass.
Thomas J. Borden,	American Print Works,	Fall River, Mass.
Thomas S. Borden,	Metacomet Mills,	Fall River, Mass.
H. C. Bowen,	Bernon Manuf. Co.,	Georgiaville, R.I.
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Jonathan Chace,	Valley Falls Co.,	Valley Falls, R.I.
Simeon B. Chase,	Tecumseh Mills,	Fall River, Mass.
Alfred D. Chandler,	Ocean Mills,	Newburyport, Mass.
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Francis Cogin,	Augusta Factory,	Augusta, Ga.
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E. S. Davis,	Continental Mills,	Lewiston, Me.
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James C. Davol,	Pocasset Manuf. Co.,	Fall River, Mass.
James Dempsey,	Lewiston Bleachery,	Lewiston, Me.
Frederic Dexter,		Boston, Mass.
George Dexter,	Pepperell & Laconia Cos.,	Boston, Mass.
John E. Downes,	Old Dominion Cotton Mills, 1411 Ross St.,	Richmond, Va.
George Draper,		Hopedale, Mass.
Wm. F. Draper,		Hopedale, Mass.
Geo. B. Durfee,		Fall River, Mass.
David H. Dyer,		Fall River, Mass.
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Charles L. Eaton,	City Machine Co.,	Providence, R.I.
Isaac Eaton,		Nashua, N.H.
John W. Farwell,	Lewiston Bleachery,	Boston, Mass.
N. W. Farwell,	Lewiston Bleachery,	Lewiston, Me.
A. R. Field,	Pacific Mills,	Lawrence, Mass.
M. F. Foster,	Langley Manuf. Co.,	Langley, S.C.
George W. Frost,	Newmarket Manuf. Co.,	Newmarket, N.H.
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Richard Garsed,	Wingohocking Mills,	Philadelphia, Penn.
Geo. C. Gilmore,	Stark Mills,	Manchester, N.H.
Charles J. Goodwin,	Indian Orchard Mills,	Indian Orchard, Ms.

George M. Goodwin,	Tennessee Manuf. Co.,	Nashville, Tenn.
W. F. Goulding,	Androscoggin Mills,	Lewiston, Me.
David Gowdey,	. . . . .	Providence, R.I.
Benjamin Greene,	Cabot Manufacturing Co.,	Brunswick, Me.
Frederick Grinnell,	. . . . .	Providence, R.I.
William P. Haines,	Pepperell & Laconia Cos.,	Biddeford, Me.
H. P. Hammett,	Piedmont Manuf. Co.,	Greenville, S.C.
Frank L. Harmon,	Warren Cotton Mills,	West Warren, Mass.
C. M. Harris, Jr.,	. . . . .	Oakdale, Mass.
Thomas Haskell,	. . . . .	W. Peterboro', N.H.
Edward B. Hayden,	Plymouth W. & C. Factory,	Plymouth, Mass.
William Hayes,	Barker Mill,	Auburn, Me.
John H. Higgins,	. . . . .	Slatersville, R.I.
John Hill,	Eagle & Phœnix Manuf. Co.,	Columbus, Ga.
J. G. Hill,	Lawrence Manuf. Co.,	Lowell, Mass.
J. P. Hillard,	. . . . .	Fall River, Mass.
Reuben M. Hobbs,	Pepperell Co.,	Biddeford, Me.
John Holland,	Cocheco Manuf. Co.,	Dover, N.H.
Stephen Holman,	. . . . .	Holyoke, Mass.
George W. Holt,	Monohansett Manuf. Co.,	Providence, R.I.
Amos F. Howard,	Dean Cotton & Machine Co.,	Taunton, Mass.
Bion B. Howard,	Cordis Mills,	Millbury, Mass.
Henry S. Howe,	Pocasset Manuf. Co.,	Fall River, Mass.
Daniel Hussey,	Great Falls Manuf. Co.,	Boston, Mass.
W. H. Jennings,	Merchants' Manuf. Co.,	Fall River, Mass.
D. L. Jewell,	China, Webs'r, & Pemb'ke M.,	Suncook, N.H.
D. W. Johnson,	Monadnock Mills,	Claremont, N.H.
D. J. Johnston,	Harmony Mills,	Cohoes, N.Y.
George H. Jones,	Washington Mills,	Boston, Mass.
Russell L. Jones,	. . . . .	Windsor, Vt.
Royal Kalloch,	Tennessee Manuf. Co.,	Nashville, Tenn.
Thos. W. Kanada,	Lewiston Mills,	Lewiston, Me.
Joseph H. Kendrick,	. . . . .	Providence, R.I.
Hervey Kent,	Exeter Manuf. Co.,	Exeter, N.H.
L. E. Kent,	Masconomet Mills,	Newburyport, Mass.
John Kilburn,	Lawrence Manuf. Co.	Lowell, Mass.
E. C. Kilburn,	King Philip Mills,	Fall River, Mass.
H. C. Kimball,	Blackstone Manuf. Co.,	Blackstone, Mass.
Richard Kitson,	. . . . .	Lowell, Mass.
Fred'k A. Leigh,	. . . . .	Boston, Mass.
J. Ivers Lewis,	Uncasville Manuf. Co.,	New London, Conn.
William Lindsey,	Weetamoe Mills,	Fall River, Mass.
Charles W. Lippitt,	Social Manuf. Co.,	Providence, R.I.
Henry Lippitt,	Social Manuf. Co.,	Providence, R.I.
A. D. Lockwood,	Quinebaug Co.,	Providence, R.I.

Robert W. Lord,	. . . . .	Kennebunk, Me.
C. L. Lovering,	Whittenton Manuf. Co.,	Taunton, Mass.
Q. W. Lovering,	Lyman Mills, . .	Holyoke, Mass.
William C. Lovering,	Whittenton Mills, .	Taunton, Mass.
Augustus Lowell,	Boott Cotton Mills, .	Boston, Mass.
Geo. M. Lowrie,	Clarendon Mills, . .	W. Boylston, Mass.
J. S. Ludlam, .	Merrimack Manuf. Co.,	Lowell, Mass.
Rufus A. Maxfield,	Nashua Manufacturing Co.,	Nashua, N.H.
Robert McArthur,	Manchaug Manuf. Co.,	Manchaug, Mass.
James E. McCreery,	Granite Mills, . .	Fall River, Mass.
Charles D. McDuffie,	Everett Mills, . .	Lawrence, Mass.
Jas. H. McMullan,	. . . . .	Biddeford, Me.
Oliver H. Moulton,	Hamilton Manuf. Co.,	Lowell, Mass.
J. Turner Morehead,	. . . . .	Leaksville, N.C.
W. H. Munroe, .	Bartlett Steam Mills, .	Newburyport, Mass.
John H. Nichols,	Dwight Manuf. Co., .	Boston, Mass.
Charles Nourse,	Social Manuf. Co., .	Woonsocket, R.I.
Franklin Nourse,	Lawrence Duck Co., .	Lawrence, Mass.
Carlos Nudd, .	. . . . .	Boston, Mass.
George H. Nye, .	Laurel Mills, . .	Laurel, Md.
Walter Paine, 3d,	American Linen Co., .	Fall River, Mass.
John C. Palfrey,	Manchester Mills, . .	Boston, Mass.
Francis J. Parker,	Monadnock Mills, . .	Boston, Mass.
Walter E. Parker,	Globe Mill, ...	Woonsocket, R.I.
John H. Parks, .	New Brunswick Cotton Mills,	St. John, N.B.
Theophilus Parsons,	Lyman Mills, . .	Holyoke, Mass.
Charles S. Peach,	Freeman Manuf. Co., .	No. Adams, Mass.
J. A. Peirce, .	Fitchville Manuf. Co., .	Fitchville, Conn.
Moses Pierce, .	Norwich Bleachery, .	Norwich, Conn.
John M. Pevey, .	. . . . .	Lowell, Mass.
H. L. Pratt, .	Samoset Mills, . .	Plymouth, Mass.
J. E. Prest, .	North Pownal Manuf. Co.,	No. Pownal, Vt.
J. M. Pusey, .	Delaware Mills, . .	Wilmington, Del.
T. G. Ramsdell,	Monument Mills, . .	Housatonic, Mass.
Roscoe C. Reynolds,	. . . . .	Lewiston, Me.
John Rhodes, .	. . . . .	Millbury, Mass.
A. Robeson, .	Fall River Print Works,	Fall River, Mass.
William F. Salmon,	Lowell Hosiery Co., .	Lowell, Mass.
H. Saltonstall, .	Chicopee Manuf. Co., .	Boston, Mass.
Wm. G. Saltonstall,	York Manuf. Co., .	Boston, Mass.
A. H. Saunders,	. . . . .	Nashua, N.H.
Benjamin Saunders,	Harbor Manuf. Co., .	Nashua, N.H.
J. H. Sawyer, .	Appleton Co., . .	Lowell, Mass.
George H. Searle,	. . . . .	Millbury, Mass.

E. M. Shaw,	Lisbon Manuf. Co.,	Lisbon, Me.
Thomas S. Shaw,	Suffolk Mills,	Lowell, Mass.
William F. Sherman,		Fall River, Mass.
Charles M. Shove,	Granite Mills,	Fall River, Mass.
James B. Siner,		Lawrence, Mass.
A. C. Slater,	Linwood Mills,	Whitinsville, Mass.
Robert R. Smith,	Greenwoods Co.,	New Hartford, Conn.
S. S. Spencer,		Lancaster, Penn.
James C. Stanley,	Greenwoods Co.,	New Hartford, Conn.
J. M. Stone,		N. Andover, Mass.
Joseph Stone,	Manchester Mills,	Manchester, N.H.
E. A. Straw,	Amoskeag Manuf. Co.,	Manchester, N.H.
Henry D. Sullivan,	Naumkeag S. Cotton Co.,	Salem, Mass.
Charles J. Sweet,	Attawaugan Mill,	Killingly, Conn.
E. A. Thissell,		Lowell, Mass.
Edwin R. Thomas,	Clinton Manuf. Co.,	Woonsocket, R.I.
Wm. H. Thompson,	Lowell Felting Mills,	Boston, Mass.
William E. Trainer,	Linwood Mills,	Linwood Sta., Penn.
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Albert F. Upton,		Boston, Mass.
J. W. Wattles,	Neponset Cotton Factory,	Canton, Mass.
T. B. Wattles,		Chicopee Falls, Mass.
John Webster,	Newmarket Manuf. Co.,	Boston, Mass.
George W. Weeks,	Lancaster Mills,	Clinton, Mass.
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Henry F. West,	Washington Manuf. Co.,	Gloucester, N.J.
Channing Whitaker	Mass. Inst. Technology,	Boston, Mass.
Nelson D. White,	N. D. White's Mills,	Winchendon, Mass.
Wm. E. Whitehead,		Lowell, Mass.
Charles E. Whitin,	Whitin Manuf. Co.,	Whitinsville, Mass.
Charles P. Whitin,		Whitinsville, Mass.
George M. Whitin,	Whitin Manuf. Co.,	Whitinsville, Mass.
Harry T. Whitin,	Rockdale Mill,	Northbridge, Mass.
William H. Whitin,	Whitin Manuf. Co.,	Whitinsville, Mass.
A. N. Whiting,	Whiting Mills,	Oakdale, Mass.
Wm. H. H. Whiting,		Boston, Mass,
William S. Whitney,	Newton Mill,	Newton U.F., Mass.
Charles L. Wilder, Jr.,	Pioneer Mills,	Meridian, Miss.
Thomas Wilmarth,		Centredale, R.I.
A. L. Williston,	Greenville Manuf. Co.,	Northampton, Mass.
George Wood,	Millville Manuf. Co.,	Philadelphia, Penn.
William B. Wood,	Continental Mills,	Boston, Mass.
Eben Wright,	Thorndike Co.,	Boston, Mass.
John H. Wright,		Boston, Mass.

Total number Honorary Members, ... 2
" " Active Members, ... 203

CALL FOR MEETING.

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION,
BOSTON, April 1, 1879.

DEAR SIR, — The stated Annual Meeting of the Association will be held at the Massachusetts Institute of Technology, Boylston Street, Boston, on Wednesday, April 30, 1879, at ten o'clock, A.M., for the choice of officers for the ensuing year, and the transaction of such other business as may properly come before it.

In addition to the topics heretofore presented, upon which discussion will be in order, the Board of Government announce that Professor J. M. ORDWAY has consented to present a report of further results in testing LIGHTING AND LUBRICATING OILS.

The facts brought out by these tests, and by the earlier report and published tables, will form the basis of a discussion in which members are cordially requested to take part.

By invitation of the Board, the subject of TEXTILE BANDS for machinery will be presented by C. J. H. WOODBURY, Esq., who has experimented upon various fabrics in this use.

The question of TARE and SHORT WEIGHT in purchasing cotton, introduced at the last meeting, will be considered, if members shall desire to discuss the topic.

An early and full attendance is earnestly invited.

By order of the Board of Government,

AMBROSE EASTMAN, *Secretary.*

PROCEEDINGS.

PURSUANT to the foregoing notice, the stated annual meeting of the New England Cotton Manufacturers' Association was held at the Institute of Technology at ten o'clock, A.M.

More than one hundred members were present.

The President, Mr. A. D. LOCKWOOD, occupied the chair.

The reports of the Secretary and Treasurer were read, and, on motion, accepted and placed on file.

The PRESIDENT. The next business in order, this being the annual meeting, is the election of officers for the ensuing year. Will you pursue the usual course of appointing a nominating committee? If there is no objection to that, I will take it as the sense of the meeting, that such is your pleasure. How shall this committee be raised?

VOICES. By the Chair.

The PRESIDENT. If no objection is made, the Chair will appoint a nominating committee consisting of five: Richard Garsed, Richard B. Borden, Benjamin Greene, Franklin Nourse, A. D. Barker. The committee will please retire, and bring in the nominations as early as possible.

The following gentlemen, upon nomination, were elected members of the Association: Messrs. John B. Straw, Lewiston, Me.; William Hayes, Auburn, Me.; David W. Cowen, Lewiston, Me.; Albert W. Flack, Cornwall, Ont.; J. W. Cumnock, Chicopee, Mass.; Haven C. Perham, Lowell, Mass.; Alfred Clark, Lowell, Mass.; Joseph H. Kendrick, Providence, R.I.; William Ames, Providence, R.I.; A. A. Barker, Three Rivers, Mass.

The following gentlemen, having retired from the business of cotton-manufacturing, upon request, were granted leave to withdraw from membership: Messrs. A. B. Burleson, S. A. Knight, John P. Slade, D. M. Ayer, William E. Sharples.

Mr. Garsed, from the Committee on Nominations, submitted the following report: *For President*, — A. D. LOCKWOOD, Providence, R.I.; *for Vice-Presidents*, — A. G. CUMNOCK, Lowell, Mass.; CHARLES NOURSE, Woonsocket, R.I.; *for Directors*, — JOHN KILBURN, Lowell, Mass.; CYRUS I. BARKER, Lewiston, Me.; HERVEY KENT, Exeter, N.H.; D. J. JOHNSTON, Cohoes, N.Y.; WALTER PAINE, 3d, Fall River, Mass.; CHARLES L. LOVERING, Taunton, Mass.

On motion of Mr. Atkinson (no objection being made), Mr. Garsed was authorized to cast the vote, in behalf of the Association, for the officers for the ensuing year, and the gentlemen named by the nominating committee were declared elected.

The PRESIDENT. That completes the business of organization, the hearing of the Reports, and the choice of officers for the ensuing year. Before taking up the business in order, as per the printed circular sent to the various members, I would call the attention of the Association to that part of the Secretary's Report pertaining to the sale or distribution of the annual and semi-annual Reports of the Association. This matter was discussed somewhat in the Board of Government, and it was thought best to refer it to the Association, for them to consider whether these Reports should be sold at the bookstores, or whether they should be confined to the members, and such friends as they might desire to furnish with copies. That is the question now before the meeting. I would be glad to have an expression of opinion from the members.

Mr. KENT. The good book tells us that we are to "love our neighbors as ourselves;" but in this case we are going beyond the requirement of that good book, and are doing *better* by our neighbors than we do by ourselves. It always seemed to me a little unjust to those who become members, and pay five dollars a year for these publications, to sell them for fifty cents apiece, or a dollar a year. The amount received is very trifling; I think the sales last year amounted only to some twenty dollars, and the influence would be to restrict the number of members. If those living at a distance can get the whole of the proceedings for a dollar a year, there is not any very strong inducement for them to become members at an expense of five dollars a year. I move that the distribution be confined to members, and such friends as they may desire to send copies to.

The PRESIDENT. The motion is, that our Reports be not placed in the bookstores for sale. Will gentlemen express their views on that motion?

Mr. GARSED. From the amount of money we received into the treasury for those books, it seems to me of very little consequence whether we sell them or not; and I think gentlemen here will agree with me, that, if they are worth any thing, they are worth a great deal more than fifty cents. You gentlemen here may not take my view of the matter. It does not cost you a great deal to come to Boston, but it costs some of the members a great deal besides their assessments. If I could get all the proceedings of this meeting in Philadelphia for fifty cents, it is not likely that I would come all the way to Boston to hear them. Therefore, I am entirely opposed to the whole matter, and I trust there will be a decided expression of opinion about it, so that we shall not have to recur to the question again. If we have any surplus, as we seem to have at times, let the members have a certain number for distribution, and reserve the balance to be distributed as occasion may require.

The PRESIDENT. I may say, for the information of such members as may not understand it, that, as the editions are exhausted, the Secretary has been in the habit of reprinting, so that the members, from time to time, especially new members who come in, are enabled to get the Reports from the commencement. Occasionally, in order to do this, he has to take some one number of the Reports, and have it reprinted.

Gentlemen, are you ready for the question on the motion of Mr. Kent, namely, that the sale of these Reports at the bookstores be discontinued? As many as are in favor of the motion will signify it by saying "Ay."

The motion was carried unanimously.

Mr. CUMNOCK. I move that the Secretary be requested to call the next meeting at the time appointed by the Government, at ten o'clock in the morning, and that we take a recess from one o'clock until two, and adjourn the afternoon session at four.

I have a special reason for making this motion.

After the discussion of the oil-question at our last meeting, my friend Mr. Atkinson invited me into the next building to see a short spinning-frame that he had arranged to test the running qualities of different oils, and, at the same time, ascertain the power required to drive the frame. I was greatly

pleased at the mechanical skill and ingenuity displayed in the arrangement. I had a desire at once to have the oil I was using tested; and, at the request of Mr. Atkinson, I sent a quart to Professor John M. Ordway, and at the same time I sent three one-quart cans of other oils from the sellers of the same. The test proved that the oil I was using stood well as to evaporation, and it had a high flashing-point, but had "much gum." One of the other oils mentioned showed as good a percentage as to evaporation and flashing-point, and had but "little gum." As the result of the test, I ordered the oil in quite a quantity, at a cost of ten cents per gallon less in price; and in the course of three weeks it showed a gain of eight per cent in power.

I have come to the conclusion, that, although the first-mentioned oil gave good satisfaction as a lubricant, it was largely due to the "gum" at the expense of the power. I hardly think manufacturers are aware how much the investigation of the oil-question has done for us, and is going to do for us in the future, in giving us oils better adapted to our wants. Power is a very expensive item in manufacturing; and any oil sold in the market, that has a large amount of gum or resinous matter, is a dear article to purchase. The discussion of this and other subjects should have more of our time and attention. We come here, and spend an hour or so, and then start for home. The hour I spent in the next building examining the spinning-frame, and watching the oil-tests, convinced me that the bottom of the oil-question had not been reached, and it was not likely to be for some time to come.

Mr. GREENE. I move an amendment, that instead of adjourning at four o'clock, we adjourn when we get through, at our convenience.

Mr. Cumnock accepted the amendment.

The PRESIDENT. The motion, as amended, is that we hold a morning session from ten o'clock until one, and an afternoon session, commencing at two o'clock.

Mr. ATKINSON. I cannot help saying how gratified I am at what Mr. Cumnock has stated. The questions that have come before me in this oil-investigation have become so complex, so difficult of determination, and yet so important, that I have sometimes almost been willing to give it up, for fear lest I was pursuing a question that others did not appreciate fully.

Not that I have had any sign of that, but it has imposed upon me a burden and a load, and I felt that I had started a difficult question, and I could not see my way out.

The PRESIDENT. The business named in the notice for this meeting is an address by Professor Ordway, in continuation of his address delivered here six months ago, on the question of lighting and lubricating oils. While we are waiting for Professor Ordway, if any member of the Association has any thoughts to give us in regard to the subject under consideration, we shall be glad to hear them.

Mr. GARSED. I would like to ask if any member present can tell us what the result of the New York Legislature was upon the tare-question. They had a bill before them to fix a tare on cotton: I have lost sight of it, and I thought likely there might be some New York members here who could tell me whether that bill passed or failed.

The PRESIDENT. I do not know whether there are any members from New York here; but Mr. B. F. Nourse is posted upon every thing appertaining to cotton, and, if he can answer the question of Mr. Garsed, I have no doubt the Association would be very glad to hear from him.

Mr. NOURSE. I have no positive information as to the legislation in New York, except that it was proposed. I had some correspondence on the subject. My impression is, that it did not pass to legislative enactment. I do not know any thing in regard to the present position of the matter.

Professor ORDWAY. It is desired that a further report should be made, in addition to what I have already given in October last; but, so far as the data are concerned, we have accumulated very few. We have continued in the examination of oils, obtaining rather empirical than scientific results. We have increased the number examined, and our work has sifted itself down mainly to the determination of the evaporation of oils, and the flashing-point. There is not a constant ratio between these two, and what we depend most on, for determining the value of any particular oil for lubrication, is the evaporation in twelve hours at 140° Fahrenheit. Of course, these numbers are purely arbitary: any other time would do; but it is necessary to have a uniform time, for the sake of comparison. I regret to say that my own attention has been so much occupied with my regular duties, that I have not been able to give the personal atten-

tion to this matter that would be desired. My assistant, Mr. Allbright, has continued the work faithfully, until he was called away to Chicago about two weeks ago. The work has been well done, I believe, and it has been confined mainly to a continuation of the same experiments that had been made at the time of the last Report; but, among other things, we have taken up the matter of the lubricating machines. We had a new machine made, differing somewhat from the former, and it was put into operation; but we found that the amount of power required was so great, that it would be necessary to wait until we could have the whole power of the engine to use, instead of depending upon what little could be spared from the use of the other machinery. The machine was tried to a small extent; but it proved, as far as we did try it, to present no advantages over the old one. Another machine, which we had at the time of making the last Report, had not been mounted and tried; but we afterwards mounted and tried it, and it has proved unsatisfactory. Mr. Allbright tried it very faithfully; and then, in order to make sure that no points were overlooked that ought to be attended to, I sent him on to the manufacturer to learn from him, or rather from his assistant, just how they had used the machine, and what their results amounted to. I told him, when he went on, that I wanted him to stay there until he got three results with the same oil on one day that agreed with each other, and one result on a different day that would agree with one of those three, at least, or with the three. I told him to stay there until that could be brought about. He stayed something over a week, and saw no signs of bringing it about, and came home. I thought that a machine which was good for any thing, or good for much, should at least give three results with the same oil that agreed pretty nearly: we did not, of course, expect a precise agreement in figures. He obtained no new light upon the subject. He simply found that the manufacturer had made the machine on a theory. He had never actually tested it, to see whether his theory was absolutely correct. We could use the machine and get results; we could get figures very easily: but we are not satisfied with that. We want to get results which will be worth something in reconciling our experiments. The machines, so far as we have tried them, and we have tried three, do not give any results which can be depended upon at all. We get merely figures, nothing else. They do

show one thing, perhaps, in a very rough way, — that, the more fluid the substance is that is used for lubrication, the more favorable are the results; and, in fact, with water, we got better results than with any other liquid that we used. I desire to say that this is a principle which holds in practice, — that the thinner the lubricant, the better would it be, if we leave every thing else out of account. But we must recollect that the thinner it is, the more rapid will be the evaporation, and the less time it will last. If we use water, we must keep up a continual supply; and if we use a thin oil, which is volatile, of course we must keep up a full supply of that. If the oil is thin, and volatilizes pretty rapidly, we must use a very large quantity. Hence we must take a medium between something which is very fluid and something which will not evaporate. Those things which will not evaporate are those things which are usually thick. If we take the mineral oils, which have a very high flashing-point, and which evaporate less than five per cent, on the exposure I have mentioned, we find they are very thick. They can be thinned by the use of a thinner animal oil, and I believe the best thing for the thinning of these thick, heavy mineral oils, is either sperm or neat's-foot.

We have not reduced the results to any scientific proposition, and we have no positive direction to give; but that seems to be the general result of all the trials that we have made so far. The vegetable oils are more prone to oxidize: they have a higher specific gravity; they are not so thin, as a general rule, as animal oils. Sperm oil is the thinnest: neat's-foot comes next to it. Sperm oil has a special advantage, in that it does not oxidize so readily as neat's-foot and other animal oils; and, when either of these thin oils is mixed with a thick petroleum oil, we get something which has a reasonable degree of thinness. And yet the petroleum tends to retard oxidation: it retards it very much indeed; so that a mixture of equal parts of sperm oil and heavy mineral oil will of course have very low evaporation and a very high flashing-point. A mixture of that sort is probably the same, as far as oxidation goes, as a mineral oil. A very small quantity, even ten per cent, of mineral oil, tends to retard spontaneous combustion; and, of course, as spontaneous combustion results from the tendency to oxidation, we may say fairly that even ten per cent will retard oxidation in animal oil, so that there will be hardly any tendency to gum.

Then, as the result of our examination of the mineral oils that are in the market, so far as they have been sent to us, we find that most of them are very good oils indeed. We find once in a while one that has a low flashing-point of 240 or 250, and which will evaporate, say nine, eight, or seven per cent, on the exposure for twelve hours to 140° Fahrenheit. Any thing that has over five per cent, so far as evaporation goes, we think is not to be recommended. I think it will be understood, from what was said in the former Report, that neat's-foot oil, sperm oil, and other animal oils, have no tendency to evaporate when they are exposed to high temperatures. There is a slight increase in weight, owing to the oxidation: there is no evaporation whatever. In other words, these animal oils contain no volatile substance, whereas all the petroleum oils are volatile; but, when we come to those that are very thick, we have them volatile at so exceedingly high temperatures, that practically they are the same as fixed oils.

It would be very desirable to obtain a scientifically accurate and precise instrument for testing lubricating oil, as to lubricating power. Whether this is possible or not, I hardly know. Besides the three forms of machine that have been used, there have been others proposed, which, however, rest essentially on the same principle, I believe; and, as I said in the former Report, any machine which has a journal with a box around it, is not a suitable form, from the fact that there will be unequal wear. Two of the machines which have been used for our trials consist of a cylinder and a bearing above it, like that [illustrating on blackboard]. The journal of one is made of steel or iron, and the other of bronze. Now, if we could have this perfectly hard, — that is, incapable of any wear at all, — the tendency of that journal is to wear up into that bearing, so that in time we should have it in *this* shape. You can never have the machine twice alike, unless you rebuild it, and cut it out at certain points of its wear. But, on the other hand, it is absolutely impossible that we should have any thing which will not wear at all. If we take the hardest steel and have it rub against bronze, the steel will wear; and the result will be, both wearing, and the journal continually growing smaller, and the bearing continually growing larger, so that, instead of the round part touching all around as it ought to, it will, after a time, touch in *that* way. Of course, this is continually wearing up; but it is

continually wearing smaller, and it never can touch except in one line. Well, perhaps that would not signify, if we could always keep *this* at right angles to the direction of motion; but we cannot. *This* line will swing round, and of course we have a harsh motion; and it is utterly impossible that any machine of that sort should work with any thing like smoothness; should not vibrate; and any vibration is fatal to a fair trial of the oil.

We have found considerable difficulty with the machines we have tried, in keeping the oil distributed on the bearing. If we have the bearing smooth, and the journal smooth, the tendency of course is for the oil to work out. Now, it is almost impossible to get one of these machines made true: it would cost a great deal of money to have it made absolutely true, and, if we had it, on account of the usual inequalities of the metal, it would be impossible for it to remain so. But suppose we have the journal horizontal, and the bearing over it true, and suppose there is a little hump near the end of the journal. Of course, if there was only that hump, and it did not tend to tip there, that would soon wear down; but the effect of the hump is that it carries the box a little out of the horizontal direction, and the consequence is that the box wears where the hump presses on it, and at the other end where the box presses on the journal; and so it will not hit everywhere exactly alike. There is a tendency to shake; there is a continual vibration, and the effect of the vibration is to cause very rapid wear. It will bring certain points of the opposed surfaces in direct contact, and there will soon be no grease where we want it. We want it on the rubbing points, and those are just the places where we cannot get it to stay. Of course, the longer the shaft and bearing are, the less will be the inequality; and we want to have those very long, not very short, as in the machine before us.

We have run this machine at about twelve hundred revolutions a minute. It consists of a steel journal, which slips on over the free end of the shaft, and is embraced by these brass boxes, which can be tightened by screwing up from below; and any pressure can be brought to bear, according to the strength of the spring inside. There are two or three springs, so that we can put on different pressures. We have tried fifty, a hundred, and two hundred and fifty pounds to the square inch. A screw at the bottom presses up against the spring, and the amount of pressure is shown by the index *there*. We can make

the pressure greater or less. But there you see we have a round box, and that is continually wearing oval. Still it would do tolerably well, if there were vibration only in a plane, at a right angle to the line of the shaft; but there is also a tendency to vibrate in direction of the shaft, which certainly must be objectionable. But the maker says that an oscillation in the direction of the shaft is a characteristic of a rightly working machine. I cannot see it. It seems to me, that, in order to make that machine work right, it should be always true and steady lengthwise of the shaft, and only vibrate in the other direction.

You can easily see what this machine is intended to do. As the journal moves round, of course it produces friction on the box, and tends to swing the pendulum which holds the box; and the amount of motion is indicated by the index here. The scale is supposed to indicate the coefficient of friction. The oil is put into a small hole, running through the upper half of the bronze bearing. Now, we found, on mounting the machine, and running it a little while, that we got a certain coefficient of friction. Then we loosened it a little bit and put it back again, and tried it again, and we did not get the same coefficient. You cannot get the oil to distribute itself well, any way you can fix it. Then, again, this bearing, contrary to what I have already mentioned as essential, is very short indeed: it has a tendency to wear oval, and there is vibration in a direction in which there should be none.

At first sight, it looks as though that machine were very delicate and sensitive; but, when you come to examine into the points I have mentioned, it seems to me that the theory of the machine is decidedly against it, and certainly the practice is very decidedly against it. Suppose there is a slight place that is projecting on either the journal or the bearing: of course, that place must wear down, and, in wearing down, it has a tendency to make a jerking motion all the time. And it will not only wear that spot, but some other spots, and the consequent tendency is to make these bearings always irregular: they never can wear true, any way; they are growing worse and worse all the time.

In using this machine it was proposed to put a definite quantity of oil on the bearings. This whole box with the pendulum can be taken off very easily; it is convenient on that account, —

much superior to the other machine in this respect. You can take out this box, put on a very small quantity of oil, — a measured quantity or a weighed quantity, — and then put it on again, and run the machine till it begins to show an increase of friction. But suppose there is a little inequality: — the metals will then soon come in contact, the oil being crowded aside. In order to test fairly the lubricating quality of oils, we must have a simple friction of the oils themselves, and no rubbing of the bare metals on each other. We should have two perfectly fitting surfaces, and keep the oil between them. It is desirable to have something which represents the circumstances that prevail in practice; and at first sight this arrangement appears to be such. Here we have a shaft and a bearing, as usual; only the bearing in this case is made of hard metal, rarely used in actual practice.

Now, it seems to me — to take up one other point — that the harder the journal is, and the softer the box is, or the greater the difference between them, the better it will be, because then they will soon wear equal, and tend to stay so. Of course there is a practical difficulty there. If we could, in fact, use mere tallow for a bearing, or something which is very soft indeed, it would do very well; but tallow would soon crush and leave no support. We all know that wood makes a pretty good bearing, if we have pretty hard wood: it adapts itself to the metal very well; but it will wear out after a while. Babbitt's metal is sometimes used, and it is certainly a very good thing. We have, in a Babbitt's metal box and an iron shaft, a very great difference in the two bearing surfaces. If there is any inequality in the shaft itself, it will soon be compensated for by the actual scraping out of the softer metal; and the tendency is to wear to a true fit. There are softer metals, like lead, which yield too much, and are, so to speak, too viscous; that is, while being abraded, they catch on the iron of the shaft, and cause a dragging. They are somewhat like resin, which catches and sticks to rubbing surfaces, and increases friction. Babbitt's metal is soft enough and brittle enough to be scraped to a fit by the harder iron, and yet it is firm enough to bear up against a pretty strong pressure, and hence comes its great utility for lining boxes.

One thing we should observe in this connection, and that is, the tendency to cohesion between metals in contact. Any thing which tends to cleanse metallic surfaces tends to make them

stick together. You know, when we want to solder tin or copper or zinc, we must have perfectly clean surfaces, or else the solder will not adhere. We scrape the surfaces to be united, and use chloride of zinc, or resin, to keep them clean till the solder unites with both. If we use a lubricating oil that is a little bit acid, and therefore tends to dissolve the coating of oxide on shaft or bearing, we get something which makes the metal bite. Any thing which is acid, which tends to dissolve metallic oxides, or tends to bring two perfectly clean metallic surfaces in contact, tends to bring about exactly the right conditions for their absolutely adhering together. We want, therefore, to get something free from acid, something that will not dissolve metallic oxides; and we want metals whose oxides have little affinity for oils, or for acid in the oils. Copper and brass are acted on by animal and vegetable oils. Iron is not. Babbitt's metal is not. Brass and bronze are objectionable on this account. I am glad to say that the experiments we have made, on the mineral oils received by us, show that most of them are entirely free from acids. The vegetable and animal oils develop by exposure more or less oleic and stearic acid, and this is an objection to the use of such oils unmixed.

I think some of you may remember the time when it was proposed to use the dead oil of coal-tar as a lubricant. It became pretty well known that dead oil rather tended to make bearings bite than otherwise. Dead oil contains carbolic acid ; and probably the biting was on account of its tendency to clean the metal surfaces, and bring them in closer contact. What we want is to have no metallic surfaces in actual contact; we want large surfaces to distribute the pressure, and we want them true, so that the oil may receive the pressure uniformly throughout the whole extent. If there is one point of metal in contact with another, we are no longer getting the full benefit of the oil. The machines that I have here have failed in this, that we can never get more than one or two points of bearing; and of course, as the prominent points of the metals soon come in contact, you can tell very little about the oil. We ought to have something which continually tends to wear true. Now, if instead of cylindrical surfaces we have disks, the chances of compensation are much better. To be sure the little brass disk-machine that we have tried is too small and too simple, and it has not proved quite satisfactory. But the true principle is to have disks,

or something equivalent to disks. Suppose two flat surfaces brought together with an eccentric rotary movement. These will tend to wear true; and, if there are any inequalities in them, they will wear spiral grooves, and by continual intercrossing the grooves will soon be effaced. The true principle of a lubricating machine, which I think will yet be developed, would be to have the motion of the painter's muller, and never to have precisely the same parts opposed to each other in any two successive revolutions. If we could have a machine of that sort, it would be a practical lubricating machine; but we have not been able to conceive of any way of bringing that about as yet. But if we have to use a simple rotary motion, as perhaps we must in order to get great speed, instead of a disk we must have a flat ring working against a plain surface. The objection to this is that the outer portion of the ring is moving at a greater velocity than the inner portion, and of course the constant wear is greater at a greater distance from the centre. The tendency would be to wear down into the disk next the outside direction; and on the other hand, when the inner portion gets a little high, that wears down. So I think there might be a very slight, but inappreciable, inequality produced. But perfection is to be aimed at; and there is one way in which we can restrict the difference in velocity between the outer part of the ring and the inner, and that is by making a conical ring bearing on a hollow cone, the proper angle being determined by experiment. The books on mechanical engineering give us, however, the exact form of bearing-surfaces which will wear exactly true. The question would seem to be between a disk-machine, which will move eccentrically somewhat, and a cone-machine. A cone-machine has been devised by Mr. Whiting, and he has favored us with the drawing which is here exhibited. A cone-machine, if it could be well mounted, would be a very good thing; but there is one point to be considered. If we have a cone, it would hardly do to have a sharp edge. It should be made rounding, and the corresponding edge of the cup should also be cut rounding, so that both cup and cone will wear off just alike.

It is essential, in order to get a machine which will indicate in a few minutes, or even in a few hours, the lubricating power, that the oil be in some way or other well distributed. Any of these things which rub together, with large surfaces, tend to work the oil out all the time. There ought to be some way by

which it should be retained where it is needed. I think this might be brought about. I use a good many "might be's," because it costs a good deal to build a machine; and, although we have a great many ideas, we cannot afford to carry out those ideas, until we get one which seems to be pretty nearly perfect.

Suppose we have a ring, which is rubbing round on a flat surface; of course there is a tendency all the time to rub out the oil. Now, I think if the face of the ring were spirally grooved, remotely like the stones of a grist-mill, the effect would be to overcome centrifugal force, which is all the time throwing the oil outward. This requires a good deal of nice adjustment, but with grooves in curves of the right form, and with rounded edges, the machine would distribute the oil evenly and retain it where it is wanted. It requires much study to get up a machine which will distribute the oil well and will wear equally, and I cannot say that we are prepared as yet to recommend any form as perfect in all respects.

QUESTION. Why not submerge your upper cone in oil?

Professor ORDWAY. That would be a very good thing if we could run it long enough; but the idea with most of these machines is to take a small quantity of oil, and run the machine ten or fifteen minutes; of course, if we took a large quantity, we should have to run it two or three days. We must either take a small quantity of oil and use it up, — that is, run for twenty minutes, or even twenty hours, until it has a chance to oxidize and impair its lubricating quality, — and then consider the time that it remains efficient, or else we must use a larger proportion, and depend upon the heat evolved. If we could measure the heat very nicely, that would do very well. This machine pretends to measure the heat. Here is a little thermometer, which is supposed to register the heat which is developed by friction. If you look at it, you will see the utter absurdity of the thing. In the first place, the bulb of the thermometer is surrounded by confined air; there is a space between it and the bearing, and heat is communicated to it very slowly, as confined air is one of the best non-conductors of heat. The bulb ought to be immersed in water or mercury. This thermometer is of very little use. It gives an indication that bears no exact relation to the amount of heat produced. Then, in the second place, we have a very great mass of metal to take

up and dissipate the heat. Here is a great box, and here is a great journal, that, in an ordinary experiment, produce a very small amount of heat. Still, that would be all very well if they were insulated so that we could measure what heat there is; but instead of being insulated they are in contact with this great mass, say fifteen pounds of metal, and the heat is being conducted and radiated away all the time. Thus the heat is diminished to such an extent that the thermometer will not indicate more than a tenth of what is actually produced. Then there is another thing: here is this other bearing very close to the one which is being tested. It is producing heat all the time, and there is nothing to show how much of the temperature indicated is due to it. The heat of all the bearings is communicated from one part to another, and spreads all through the machine in every direction. Moreover, when the machine is moving with a high velocity, the air is rapidly impinging against it all the time, and tending to cool it.

To make a friction-machine capable of acting as a calorimeter, we must surround the rubbing disks or cones with wool or eider-down, and keep in the heat. This looks easy enough; but, in practice, a calorimeter of that sort requires a great many little contrivances before it can be made complete. What we want is disks, which should be insulated by wooden connections; and not only that, but the disks should be cut off from radiation, conduction, and the convection of the air; and then we might get indications philosophically correct. But with such a machine as either of those before us, there is nothing definite to go by. We find, in the first place, that there is a lessening of friction. Why? It is because heat is produced, that warms up the oil and makes it thinner, and then there is less friction. You come after a while to a balance; but the first effect, immediately after starting, is a diminution of friction. At the first start, when the oil is cold, of course the pendulum of one of the machines is drawn up a considerable distance. After a while it begins to come back again, because the oil is getting thin. By and by you get to a poise, and then, after running twenty or thirty minutes, it begins to come up again. If we could take off the box, put on more oil, and get the same result again, it would be very well; but that we have never been able to do. I don't think it is for want of care in the operator; I think it is owing to a defect in the machine, and I have more

than one reason for thinking so. The journal of this machine, when we first tried it, was found not to be exactly right, and the maker promised to make one that should be exactly right. It was sent on to us as being about as good a thing as they could make. We found, in running, that the journal, instead of having its edge parallel with the axis, was crowning. That was the best they could do in making a perfect machine, I suppose; and, in order to make it fit the bearing, we had to scrape out the bearing. The effect was shown on the metal. After running a while, it left a very bright place in one spot; after it was run some little time longer, it left a bright place in another spot, and we had to scrape the box to fit the unshapely journal. But after getting it right it will not stay right. Again, the tendency of a weight bearing on an unsupported shaft-end is to bend the shaft. That is not a very great defect, because the shaft is tolerably stout, and the unsupported end is short; but still there is a tendency that way, and that tendency of course increases the tendency to vibrate in the direction of the shaft. I hope that sometime, by the help of more ingenuity than has been brought to bear upon this subject yet, there will be a good machine to determine friction by heat, and there will be another to determine it by the lubricating power merely. In order to determine it by the lubricating power, we must use a certain measure of oil every time; so many drops, of the same size, of course: or we must use a certain weight, so many *milligrammes*, and use it until it is worn out. With the heat-machine we could keep the oil in excess all the time, and thus get rid of some of the objections which lie against distribution, or make distribution much more perfect. I should like to have the results of a heat-machine of the right character. I believe the thing can be brought about; and yet you will find, in all the machines that have been produced, from the first one down, an enormous mass of metal not insulated. Some of them have no provision for registering the temperature. Two of those before us have thermometers; but what do their indications amount to? In order to have any thing like accuracy with either of these machines, it will be necessary to have the room in which the machine is used at precisely the same temperature, and not to open a door or window while the experiments are going on. It would be a great deal better to have a machine that can be insulated than to insulate the room.

I should say, in passing, that there is, in one of the late numbers of the "Engineer," a description of a machine which presents some very good points; but it is liable to some of the objections I have already mentioned. It is a disk-machine, however, and it is the latest thing of the kind, I believe, which has been constructed; yet there is room for criticism. It is easier to criticise, I must say, than it is to make the thing as it ought to be; still, there has been improvement, and there may be improvement which will go still further.

QUESTION. Will you be kind enough to state the percentage of divergence when you changed that, and undertook to put it back in the same way?

Professor ORDWAY. In two successive trials, we find that the coefficient of friction will be six pounds at one time, and nine at another. It is so great a divergence that it is perfectly absurd to suppose that both of them can be correct. It is customary for some people, in cases of this kind, to take an average; but an average of errors will never do. Two wrongs will not make a right; but people frequently go on that principle. They would try a series of experiments, and get as the result of one six pounds, another nine, another seven, another five, take an average of them, and call that right. But I don't think any of them would be right, with this machine as it is. We have found that this machine is useful only for one thing, and that is to test the fluidity of oil; and fluidity can be tested without the use of an expensive machine. We had already determined fluidity by a very simple instrument indeed, which any glass-blower can make in two minutes. We simply take a glass tube, and blow a bulb in it like *that*, and make a very narrow outlet, and suck up the oil until this bulb is full, and then let it run, and count the number of seconds that it takes to run down to this point. In that way we can determine fluidity with precision. Of course, the temperature must be the same. Of course it is necessary to surround this pipette in such a way as to insure a uniform temperature, to know precisely at what temperature the trial is made, which is an important thing.

In addition to what I said in the other Report, of the value of the chemical test, I have one observation to make. In testing olive oil and lard oil, we get a very good indication as to the goodness of the oil, or the amount of adulteration by nitro-sulphuric acid, as it was called by Mr. Roth. This is made by

passing nitrous fumes into sulphuric acid, at 46° B., for eight or nine days. We have found that by adding one or two per cent of nitric acid to the sulphuric acid at 46° B., we can get as good results in ten minutes as we can get in ten days by the other method; and, although Mr. Roth recommended this liquid as likely to keep for many months, we find that it deteriorates. We found that some made not long ago had lost its efficacy entirely, and it had to be charged up again with nitrous fumes, which, however, could be done in a few moments. The best test of the excellence of olive and lard oil, I believe, is this one. If you stir up this Roth's liquid, properly made with olive oil, it solidifies in an hour or two. Other oils will not solidify; and, if there is an admixture of cotton-seed oil, it makes the pasty mass which I explained in the former Report.

There is one point to which I wish to allude, not because I have made any experiments, but because there may be some popular fallacy respecting it. Some people think they can judge of oil by the feel of it. If an oil feels greasy, it only shows that there is something in it of the nature of the oil of our skin. Petroleum oils may not have that peculiar feel, and yet they may be very good lubricants. We must remember that point, — that what dissolves oil may still be a good lubricant. It has the property of dissolving away that oil, and not leaving one which is precisely equivalent to what we are accustomed to. Hence, I think you may be deceived sometimes in judging of petroleum oils. They do not quite agree with the skin; they will not touch it, and do not lubricate it in the same way that the human fat does.

I mentioned in a former Report that we had found sperm oil, in all the various trials we had made, to be a very valuable oil. We have not had time ourselves to investigate this subject; but two of the young men who are about to graduate from the Institute have had the matter of sperm oil under scientific investigation, and I hope in a few weeks we shall have some results which will be worth something. The peculiar composition and character of sperm oil are matters which have never been fully investigated by anybody. These young men have found that there are some important substances in sperm oil, which are not to be found in ordinary oils.

I heard, after the Report last autumn, that I had spoken a good deal of "saponification," which, being a chemical term,

everybody did not understand. I mentioned some of our trials of saponification, which had reference to the oils for greasing wool. You all know that it is desirable to have, for that purpose, an oil which can be removed from wool with little trouble, after the wool has been carded and spun and woven. We want an oil which will saponify readily. By "saponification," we mean making the oil into a soap, which is really soluble in water. That is the old-fashioned explanation. As we explain it nowadays, it is the decomposition of the animal or vegetable oils into stearate, oleate, and palmitate of soda, or potash, and glycerine. Lard oil is a compound of oleic and stearic acids and glycerine. This compound, however, is not very easily decomposed. We have to boil lard oil for a long time with caustic alkali, in order to effect the decomposition. There is a wonderful difference in oils, with respect to the ease with which this decomposition takes place. Sperm oil saponifies with great difficulty, and it is a better oil for lubricating purposes, for the very reason that it is not so readily decomposed as others. On the other hand, it would be very unsuitable for oiling wool, for the same reason. It will not be quickly dissolved in alkali, and taken away from the wool. Those oils which saponify most easily are the best for oiling wool. For instance, if we take lard oil, and separate the oleic acid, that oleic acid, having once been formed, is readily dissolved by caustic soda, or common carbonate of soda. That is the reason why oleic acid or red oil, which is so much used, is a superior article for oiling wool. It is not a compound which requires to be broken up.

There are some scientific points connected with this, which I am not prepared to say much about, because we have not had time to investigate them. I believe red oil is the best oil for oiling wool; but there is the difficulty of spontaneous combustion. How this can be remedied, I do not know. People talk about saponifying petroleum; but it is utterly impossible to saponify petroleum oils, because the petroleum does not consist of an acid and a base, or any thing comparable with glycerine. There is nothing in petroleum which can be made to combine with potash or soda. People who talk of saponification, in connection with petroleum, are deceived by considering emulsionation as saponification. You may stir up petroleum with potash or soda, and it will emulsionate; it will form a milky liquid; it will become suspended, and may remain in that condition a

month or two: but that is not saponification. The petroleum will finally separate unchanged. The great question seems to be how much petroleum oil may be mixed with red oil, and be mechanically removed from the woven cloth by emulsionation. I cannot say that I have experimented far enough in that direction to be able to answer the question. Sperm oil consists of something besides glycerine. Glycerine oxidizes very readily in the air. For instance, if we take linseed oil and expose it to the air, in a very short time the glycerine in it begins to oxidize. Linseed oil contains a peculiar acid, called linoleic acid; and, when it is exposed to the action of the air, the glycerine is all oxidized, and disappears as acetic, formic, and other volatile acids. That is one reason why lard oil and olive oil, which are disposed to oxidize, become rancid so much more readily than some of the animal oils, which contain less glycerine. Sperm oil contains some, but it contains chiefly a base which has less tendency to decompose by exposure to the air. And there is one oil, that Mr. Atkinson will speak of pretty soon, that has still less tendency to decompose, and that is an oil which comes from sheep's wool. Sheep's wool has no glycerine in it. It contains cholesterine in the place of glycerine, and cholesterine has no tendency to oxidize. And that is the reason why the oil in sheep's wool is not prone to spontaneous combustion.

So far, I may say that our experiments on oils have resulted mainly in demonstrating that it is important to have an oil that is not particularly volatile, and which is free from sediment; and, at the same time, the thinner we can get it for spindles and the like, the better. But it will not do to thin it down with light oils, petroleum or any thing else, which will volatilize: we must thin it with something that has no tendency to evaporate whatever. We can only accomplish that by the means I have before mentioned, — by mixing a fixed oil with it. The question is, which fixed oil it should be. Sperm oil is less liable to oxidation than some others, and it would seem to be better on that account. Sperm oil is lighter, thinner: it has less specific gravity than some other oils, and it is a little more suitable on that account, perhaps.

QUESTION. What effect will be produced by mixing gum with a mineral oil?

Professor ORDWAY. It will, of course, tend to increase its adhesiveness, or cohesion. It will make it more like tar; and,

of course, the more like tar it is, the greater the friction. We do not want any thing which is so hard to pull apart as tar or resin. Resin itself is never quite solid. If you put a mass of resin as big as your fist on this table, in the course of time it will flatten out. It adheres quite as much to any other body as itself. If we let it spread out on this table, we cannot get it off again without using a great deal of force; whereas oil will pull apart very readily. The particles of resin, so to speak, felt together, interlock each other, and make a tough mass; whereas the particles of oil seem to be spherical, and roll over each other with ease.

Mr. ATKINSON. I understand that in some of these mineral oils, although no gum is put in, a certain apparently resinous, gummy residuum is to be found, according to the manner in which the petroleum has been converted into lubricating oil. Am I right, there?

Professor ORDWAY. That is the case. All the petroleum oils that we have examined, I think, show, when treated with Roth's liquid, a slight amount of matter which is gummy, sticky. It forms a black film on the surface of the acid. Whether this exists in petroleum in such a form as to interfere with its lubricating qualities, I cannot say. The amount is commonly so slight that I think it can be entirely neglected. In most of the oils that we have examined in the last three months, we have found the amount very small: but it is always there; and, owing to its presence, we can generally detect petroleum in an oil if it is there to the extent of ten per cent. Of course, if there is only a very small amount, it takes an experienced eye to see it.

QUESTION. Has there not been an improvement since this investigation was started?

Professor ORDWAY. I am very happy to say that there has been a great improvement in oils since this investigation was started. I think it argues very well for the wisdom of starting this investigation.

A MEMBER. Crude petroleum must have grown better! [Laughter.]

Professor ORDWAY. Let us throw the veil of charity over the matter. The poorest oils are nearest the surface; and, the more we draw of the deep oils, the better oils we shall get. The producers are getting deeper down, and perhaps that is the explanation.

QUESTION. Do you find a different proportion of gum in the different oils? And what is the difference in that respect between mineral and animal oils?

Professor ORDWAY. This particular substance, which occurs in mineral oil, is quite different from what is shown in the others. Gum occurs in the animal and vegetable oils only when they have been exposed to the air for some time, and become oxidized. In petroleum oils it exists as soon as they are manufactured; it is there all the time. I am not aware, that, in the case of petroleum oils, it is increased by exposure to the air. That is a point I have not been able to determine yet.

QUESTION. Do you find it is increased in the other?

Professor ORDWAY. We have not used it long enough to find out. In all our experiments with the machines, we have only run them a short time. The machines that we have are calculated for a fifteen or twenty minutes' run: we cannot answer that question until we get better machines.

A MEMBER. As I understand you, the further you go with these frictional experiments the less satisfaction you get.

Professor ORDWAY. That is about the way, really. As I said in the outset, we have been making empirical trials: we have yet to make trials which will give us a scientific basis. It was necessary to make these empirical trials, because we found some oils that were known to be pretty bad, and it was suggested to me that we must make as many trials as possible soon. We have therefore been contented with empirical, or practical, trials at first. Results from experiments on a scientific basis are harder to get. As I mentioned with reference to these two young men who are experimenting with sperm oil, we want to know what sperm oil is. They have been at work some three months, and they ought to have two or three months more. Their results will be of value; but I do not think they will exhaust the subject, in the time they have to spend upon it. In the same way a hundred matters come up, each of which requires, for its scientific investigation, months of close study and careful experiment. In any such matter, the little light we get serves to make the surrounding darkness the more apparent. But we have this satisfaction, that we have swept away a great deal of rubbish; and, when we have cleared the ground, I hope we shall be able to build up something.

QUESTION. Is this gum, which is found in oil, what is known in the market as paraffine wax?

Professor ORDWAY. As a general thing there is more in the high-grade oils than in low grades, but we have had some high-grade oils which show but very little indeed: there is a difference in the method of manufacture, I suppose. It exists, I suppose, in all the oils; but in distilling and filtering it seems to be got out, to a great extent. It is barely possible that some of the oils, which show a small quantity, may be from different wells. We have no means of judging whether the oils that are brought to us come from Canada, or Pennsylvania, or from any particular wells. We have no information on that point; but we have had oils of very high grade that showed very little of it, and others of a moderately high grade which showed it much more distinctly. There is something, also, no doubt, in the care which is used by the manufacturers. Whether it is paraffine wax, or not, is more than I can say. We have found so very little of it in our trials, that it is difficult to make out what it is. "Paraffine wax" is an indefinite term, — nobody knows precisely what it is. There is a substance which is called "petrocene." I can hardly say whether this is petrocene. What they call "petrocene" is a substance of a very pale yellow color. This is pretty dark, and I presume it is not quite the same thing: it probably contains some oxygen. Most of the substances from petroleum are free from oxygen: they are simply hydrocarbons. Even kerosene oil will show some of this stuff.

Mr. ATKINSON. I would state, on this point, that the oil-manufacturers have admitted that they have not yet discovered any method of treating petroleum which will enable them to remove entirely this dark-brown, gummy, adhesive substance; but they say that the quantity is much less in one kind of oil than another.

QUESTION. In this oil which is called "stainless oil," which is made from paraffine, has any of this gummy substance been found?

Professor ORDWAY. Yes, sir, it is found in that as in the others. We have found none that was entirely free. Every thing of petroleum origin, which we have reason to suppose comes from petroleum wells, we have found to contain it, more or less.

Mr. ATKINSON. It is my function not to fear to present deductions before this Association from the investigations going on. Whether they be worth much or little, they will perhaps

set you thinking, and it is for those who are skilful to avail themselves of even hints that those who know little may present to them. You observe, undoubtedly, that an attempt is made to reach an absolutely scientific point in these investigations, and that is wise and well in their conduct: but all your practice, and all our practice as manufacturers, is, of necessity, empirical; we do the best that our knowledge of the science, bearing on the question, will permit. Now, as these attempts at reducing this subject of friction to an absolute science have been going on, I have been observing them from the stand-point of the spinner, who must avail himself of science just as far as circumstances will permit, and who can go no further; and, although absolute scientific results have not been reached, there have been some points made manifest, which, with my limited practical knowledge of spinning, have seemed to me important to be presented to you, who are practical spinners, to see just what they are worth.

The experiments with the machines, constructed for the purpose of testing the lubricating qualities of oil, have not, as has been stated by Professor Ordway, yielded definite results, for which scientific accuracy can be claimed; nor does it appear that any of the machines that we have tried can be made to do so. But certain deductions can be made from these trials, and by a comparison of the results with those obtained by Mr. Woodbury on our small spinning-frame, by means of the application of thermometers to the step and bolster of each spindle, I think we got some facts that are valuable.

It appears that fluidity is an important factor in a good lubricant for small bearings and high speed, and that many oils, that are not among the best at the start, become good, when either the heat of the room or the heat of the bearing causes them to become fluid.

On the other hand, some of the oils that are very fluid, and also very volatile, cease to be good lubricants, as they evaporate, and can only be kept good by constant renewal and the use of an excess in quantity.

In respect to one kind of heavy or non-fluid mineral oil possessing a high fire-test and a low rate of evaporation, the step of the spindle heated about nine and a half degrees, and the bolster rail about eight degrees; and, when thus heated, the spindles ran smoothly, and at a certain rate of power.

A lighter or more fluid oil, also possessing a high fire-test and a low rate of evaporation, worked a heat of the step six degrees, and bolster seven degrees, and as far as we could ascertain at the same rate of power as the oil first named. Both these oils were safe and durable, and are used in mills working at a minimum of cost and quantity.

The work of the oil on the spindles, measured by the heat developed, therefore, confirms the deductions made from the use of the regular testing-machines; viz., —

That in respect to a good lubricant and safe oil for use on spindles there are now *three* factors determined.

1st, A high fire-test, not less than three hundred degrees flashing-point.

2d, A low rate of evaporation, not exceeding five per cent in twelve hours, at one hundred and forty degrees.

3d, Fluidity.

These qualities can all be obtained in the same oil, and are all to be found in some of the best oils now in the market.

Fluidity, to a sufficient degree, can also be imparted to a heavy or non-fluid mineral oil by the admixture of pure winter sperm, or pure neat's-foot oil.

If I am wrong in calling special attention to these points, Professor Ordway will correct me.

Now, I wish to call your attention to some questions in this connection, that seem to me of great importance. I submit the theory, and you will say whether your experience confirms it or not.

I have always been under the impression, that the excess of power often required in starting in the morning, and the bad work that often ensues on damp mornings, or on mornings following cool, damp nights, were to be attributed to the contraction of cotton spindle-banding. In all the discussion of this question of banding, reference has been made to an assumed contraction of the bands, by every one with whom I have conversed on the subject. You may, therefore, be surprised, when Mr. Woodbury proves to you, that neither humidity nor dryness contracts a cotton spindle-band of any common kind, except perhaps in a very small degree, and for a very short time; but that the exposure of the banding to humidity causes the band to stretch, and to remain stretched, so that the bad work must be attributed to the want of tension in the bands, and not to an

excess of tension; and the excess of power required, especially on some Monday mornings, must be sought in some other cause than contraction. I think I shall show you that when you use an excess of power on a Monday, or any other morning, you are exerting such power in stretching all your spindle-bands; that you are thereby making conditions for bad work, and that you do not get back to good even yarn until after you have re-adjusted almost all your bands.

Let us assume certain conditions, to wit: —

A hot, damp dog-day.

A cool, damp September night.

An oil on the spindles that does not become fluid until the bearings are heated four or five degrees.

In the hot, damp day your bands all become moist; they remain moist all night, and in the morning are all in condition to be stretched when pulled upon, although while at rest they may contract a very little.

In the cool night the oil ceases to be fluid, partly on account of the coolness, partly because, when at rest, in an even temperature, it is less fluid than when worked.

In the morning every bearing sticks; you apply your power and you need an excess, not only to overcome the inertia of the metal, but also to create the heat to make your oil fluid. The moment you apply your power, you stretch every band to its utmost: your works run badly; you lose twist. You find fault with the cotton and the roll-covering; but is not the fault to be divided between the oil and the cotton band? Am I not right in my inference, that you do not get good work again until you have re-adjusted all your bands?

What are the remedies?

1st, Put more steam-pipe in a spinning-room and not less than in other departments, as is now your practice.

2d, Let heat into your spinning-room on cool nights succeeding hot dog-days before starting work.

3d, In winter, keep on the steam over Sunday, and do not start spinning in a cold room even on a dry day, because even a dry cotton band will stretch.

4. If there is any virtue in the composite band made of linen and cotton submitted to-day, try that.

In other words, the conditions of good spinning must be to have the bearings in condition to start with the least excess of power, and to use a band that will not stretch.

In many mills, I am aware these rules are partly or wholly established already; but in many more some or all of them are not practised, especially in the dog-days. If I were in charge of a mill, I should test these observations by overheating my spinning-rooms two hours before starting. I would not put less steam-pipe in a spinning-room than in other departments, as is sometimes the practice.

Having observed the facts in respect to the stretching of cotton banding, especially that protected by a solution of paraffine wax which stretched worse than any other, it occurred to me that a composite band might be made to serve a good purpose. I had no special reason, except that I knew experiments had been made with worsted bands, nor did I know that cotton and linen had ever been used before.

I sent to the Silver Lake Company for some cotton bands with linen core, and the same with worsted core, and afterward had some bands made of cotton and linen twist, and some cable-laid bands of cotton and linen. Mr. Woodbury will give you the result of the tests of these bands.

It appears that the same humidity that causes cotton to stretch causes linen to shrink; and therefore, if the two fibres are combined mechanically in the right way, you have a compensation band.

Professor Ordway explains the reason. The fibre of cotton is a spiral, twisted ribbon. Humidity relaxes the twist, and causes each fibre to extend in length.

The fibre of flax is a straight, jointed cylinder. Humidity swells it laterally; and, if the fibres are twisted together, the expansion of the fibre hardens the twist, and shortens the strand.

Here seems to be a sound principle; but the difficulty comes in fastening the ends. The band is hard, and the knot is an obstruction. If you cannot fasten without a knot, you may at least use a more open V in your whorl, as the danger of slipping will be less in this band than in cotton if it is put on with a uniform tension.

I trust, however, that Mr. Draper has solved this difficulty of fastening the ends of the bands. If he has not, he knows the dreadful consequences with which he is threatened.

We desire to say that the matters treated in this statement are suggestions from our partial tests, and are not yet complete.

To prove them will require longer time, and a series of minute observations with the spinning-frame. We lost a good deal of time in attempting to apply dynamometers, and in proving that our anti-frictional machines were not suitable for our purposes.

I now wish to call your attention to another of our observations, while testing oil on our small frame, which may mean something and may not.

If the rotary motions of a spinning-frame impart a sideway vibration to the frame or its attachments, such a vibration must result in the wearing away of the bearings of the spindles on one side. I understand that this wear has frequently happened, and that in some special cases there has been a very rapid deterioration of the spindles, steps, and bolsters from such wearing on one side, and of course such wear implies the requirement of more and more power, with increasingly bad results in the quality of the yarn.

Our little frame is six feet long, and contains twenty-four Sawyer spindles on one side. In order to support the thermometers by which we measure the heat of the steps, we attached a board five feet and a half long, five inches wide, and seven-eighths of an inch thick, distant five inches from the frame, and fastened to it at each end.

The rotary motion of the machine imparts to this board a very curious sideway vibration, having a certain rhythm according to the speed of the machine. From a dead point as to the whole board, the vibration rises to a maximum in a certain time, which vibration is marked by a double curve from a central dead point; after reaching its maximum, it recedes until the whole board is still, then repeats, and so on. It is clear that the spindles must be affected by the same causes that vibrate the board, and that they must be worn away on one side. It seems to us that a remedy may be found for this mode of vibration.

Note. — Since making this observation on our experimental frame, I have observed the working of many frames in several different mills, and I find a very great difference in this matter of lateral vibration. In some frames it is scarcely perceptible, in others excessive: it does not appear to follow the weight of the spindle, or the full or empty bobbin; neither is it to be attributed to the drag of the traveller. Our experimental frame had neither bobbin nor traveller attached. It has been suggested that the cause of vibration is in the motion of the spindles themselves, and cannot be

avoided; but it seems hardly possible that so many spindles could work such uniform rhythm in the vibration, and I cannot but believe it has something to do with the cylinder or other operating parts of the machine; and that if the spindle-rail were cut off from the frame by a buffer of lead, wood, or rubber, it might prevent the action of the vibrating force, whatever it may be.

Mr. BIRKENHEAD. Is there any loss of speed in the stretching of the band?

Mr. ATKINSON. That Mr. Woodbury can tell you, when he speaks of the experiment he has made on bands.

REMARKS OF C. J. H. WOODBURY, ESQ.

MR. PRESIDENT,—While making some experiments upon the power requisite to operate a spinning-frame under certain different conditions, I found that the power required to drive the frame varied so much with the tension of the bands, that this varying circumstance, for purposes of experiment, must be eliminated, by having an equal tension to the band turning each spindle, that this tension must be known, and preserved constant. These requirements seem equally important for economy of production. To turn the spindles with a constant band-tension just sufficient to produce the desired twist without slipping on the whorl, and, on the other hand, avoiding an excessive stress which would cause unnecessary friction, I believe would lead to a saving of power greater than that claimed by any spindle-maker for his spindle over those of his competitors. That is, the difference of power, caused by correct and false band-tension, is greater than that between any two rival spindles. By weighing the band-tension in various mills, it was found that the practice of tying bands lacked uniformity. As an example of this variation, in one mill the bands on a single coarse frame are reported to vary from one to sixteen pounds; in another mill, on finer work, taking a number of spindles at random, the variation was from one-half to two and a half pounds; and in a third mill the band-tension was between the limits of one-fourth to five pounds. Now this haphazard method seems hardly mechanical.

Is it not worth while for each spinner to learn the proper band-tension required for his special work, and then endeavor to keep within those limits? The changes constantly occurring in the cotton bands used, present an obstacle to carrying out these plans.

In accepting the invitation of your Board of Government, I do not expect to impart any new information upon the question of changes in length of bands, except so far as to give matters of detail connected with accurate measurements of these alterations in a number of bands. These measurements were taken by the following method: Two upright posts were firmly fastened against the wall, about ten feet from each other: the samples of banding were extended between these, one end being fastened to a hook, and the other passing over a leading pulley to a weight. In order that the fibre of which these bands were composed would be as free as possible to expand and contract, it was desirable to use a light weight. By experiment, I found that with a weight of two and a quarter pounds, the band deflected only one-tenth of an inch from a straight line. A scale against the wall connected the tops of the upright posts; and a sliding framework carried two plumb-lines (fine wires), hung at right angles to the banding. When the samples had been under tension of the weight about two hours, this framework was slid, until the wires coincided with the division one hundred inches on the scale; then the corresponding length was marked on the banding with red cotton, and this point, also one hundred inches from the extreme end of the sample, was used to measure the dilatation in length, by sliding the framework until the plane of the wires coincided with the mark, then reading the distance on the scale above. In this manner I have taken about forty-five hundred readings, all of which were measured upon the same scale, and under equal conditions of accuracy, during a period of three and a half months. The apparatus was simple and rude in general construction, but it was sufficiently accurate to indicate a variation of less than one-fiftieth of one per cent in the length of the samples of banding.

It must not be understood that by this method I assume to reproduce the exact circumstances to which a spinning-band is subjected when in operation, but simply to maintain the bands subject to a constant tension, under the conditions given above, which, being applied in an identical manner to each sample, yield comparative results, giving the correct relations of these samples to each other when acted upon by the same specific causes.

A wet bulb hygrometer hung near the banding, and the

readings were noted whenever a measurement of banding was taken. From the comparison of the relative humidity, temperature, pressure of the vapor in the atmosphere, and grains of water per cubic foot of air, it was observed that the changes varied with the differences of the relative humidity, and also increased with the continual tension of the weights.

Referring you to the diagram showing the changes in the length of the bands, we "took the weather as it came," until the twenty-third of January, when we endeavored to reproduce the conditions of a dog-day, by admitting steam into the room, until the desired humidity and temperature were obtained. Although the temperature was not in excess of that frequently reached, yet the effect of the moisture made the room seem much warmer; and swarms of insect-life threw off their winter torpor, and issued from the cracks in the floors. This moist atmosphere caused all the bands, except the one with the linen core, to stretch. On the twenty-sixth of March the same experiment was repeated, with similar results. With slight increase of humidity, the bands contracted very slightly; and, with large increase of humidity, the same bands stretched.

Moisture, causing cotton fibres to expand laterally, shortens the length of the fibre by increasing its twist; if by excessive moisture the twist is increased largely, the fibres would be freed from the interlocking of the convolutions to such an extent, that, if there was a tension upon the whole cord, it would be lengthened by the slipping of the fibres upon each other. On the other hand, if the band had been stretched to the limit of elasticity, the fibres would be drawn in such close union that they could not separate easily, and only the contracting effects of moisture would be shown, without being followed by excessive stretching.

With different textiles, these changes would cause variation to the extent that the adhesion of the fibres to each is changed by alterations in their diameter.

Mr. Edward Atkinson suggested that an absolute band might be obtained by combining different fibres in a proper manner. It was considered essential that the outside of the band should be of cotton, as this seems to be the only substance used for textile bands, which does not polish long before worn out. Two bands of this description were made, with cotton braided outside, one of them with linen, and the other with worsted,

core. This method of combining the two fibres I believe to be original with Mr. Atkinson. Cotton and linen have been twisted together by others; but such combination does not wholly accomplish the object, as the linen seems to lack sufficient resilience to check the stretch of the cotton, when the linen threads are twisted among the cotton. I have been informed that cotton and linen bands have been successfully used for wet-twisting by Mr. T. Merrick of Holyoke. Mr. Edward Kilburn writes that worsted bands were once used for cotton-spinning at Lonsdale, and resulted in a saving of one-sixth of the power, until the expiration of about two months, when they became so polished by wear that it was necessary to take them off.

In three months and a half the linen-core banding stretched one per cent, and cotton banding five per cent. The daily results given are the average of a number of readings.

Your attention is called to the fact, that, while the band with worsted core changes in coincidence with the variations of the relative humidity of the atmosphere, the band with linen core changes in an inverse manner.

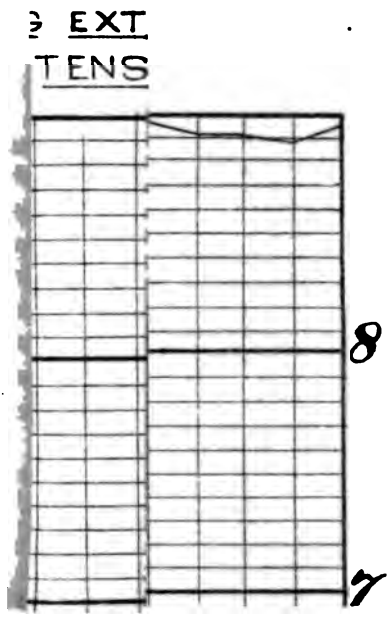
With this, I submit the chart, and the results of the observations upon which they are based.

(See pages 73–74 *post.*)

Mr. BIRKENHEAD. Have you discovered any difference in the rate of motion of a pulley driven by an elastic band?

Mr. WOODBURY. No, sir.

Mr. BIRKENHEAD. I ask for this reason. Previous to the war I was employed as a machinist in a mill; and, my attention being at one time called to two spinning-frames which were running at different rates of speed, I was led to investigate the matter. The overseer, who was at the time competing with others in other mills, had noticed that there was a difference in the production of the two frames, and was naturally anxious to remedy the difficulty. If I recollect aright, there was a difference of from six to eight revolutions in the speed of the front rolls, which made a difference of over ten per cent in the production. I spent some time in endeavoring to ascertain the cause. I placed my hands on the pulleys to see if I could discern any difference in temperature, but all seemed perfectly cool, with no indication of slip or friction. I compared the twist gears and the cylinder gears, and found them all to agree. I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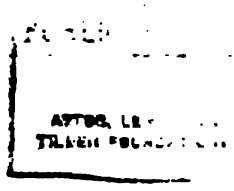

measured the pulleys on the frames and counter-shafts, and found no appreciable difference in the size. There were two counter-shafts between the loosing frame and the line-shaft, requiring three belts to transmit the motion. I puzzled over the matter for some time, but was unable to account for the loss, and finally let the matter drop. The difference in speed was nothing unusual, however, as in my previous experience I had found it an exception, rather than a rule, to find two frames running the same speed.

Twelve or thirteen years passed by, until one hot day in summer, when I was travelling in the cars, having on a straw hat with an elastic string attached, I found myself winding this string around my finger, and noticing that one inch of it was sufficient to stretch several times around according to the tension I put upon it. I conceived the idea that here was the solution of the mystery of the difference of the speed of the frames, being well aware of the great amount of elasticity of a leather belt. (For the benefit of those that have not given this subject much thought, nail one end of a belt to the floor, and pull on the other. By so doing, you can see how accommodating a belt is, whether old or new; new being the most pliable according to the soundness of the leather. Let it be about one inch wide, as you may not have strength to stretch a wide belt.) Now, supposing this to be the case, we will imagine this to be a driven pulley, and this the driver of equal diameter. Then suppose the driven pulley is carrying a machine which acts as a brake of about one-horse power in resistance to motion of belt; this resistance all on the upper side, as shown by the straight line (in practice, to get the best results from a belt, the sag should be on top). The resistance of the driven to that of the driver creates a stretch of the belt, of, say, one-half inch in twelve, making twenty-four inches of belt twenty-five inches long: this stretched belt passes on to the driver pulley, and remains in this condition until it is about to leave the pulley, when it contracts itself to its natural condition, namely twenty-four inches long on the sag side, which passes on to the driven pulley in its unstretched condition; it will readily be seen by this, that the driver will have to perform twenty-five turns to the driven twenty-four. In other words, suppose we put on an elastic or rubber string that will stretch, by a suitable resistance, one inch into two: we then have two turns of the driver to one of the driven. As I have

before stated, there were three belts between the line-shaft and the frame: this being the case, we find it necessary to multiply the half-inch stretch by three, which gives us in round numbers twenty-five turns on the line-shaft to twenty-two on the frame, supposing all the pulleys alike in size.

Engineers that have figured on the speed of machinery from the first motion find themselves invariably come short of the result sought for, unless their long experience has taught them to look out for what they would naturally call slip of belts, and take it for granted that there lies the cause of deficiency. I would here suggest, that a belt might be made non-elastic by cementing on its back a non-elastic substance.

Professor WHITAKER. The stretching and shrinking of a band or belt undoubtedly affect the relative number of turns of the two pulleys which it connects, as Mr. Birkenhead has inferred. The ordinary theory is correct enough for most practical purposes. It assumes that the inner surface of the belt, or the surface which touches the face of the pulley, is *flexible*, but not elastic; in other words, that this surface bends, but does not stretch or shrink: the belt is supposed not to slip on either pulley. It follows that the face surfaces of both pulleys and the inner surface of the belt run with the same speed, and that the number of turns of the driver divided by that of the follower equals the diameter of the follower divided by that of the driver.

Again, if an unstretched band or belt be laid upon the face of a pulley, its outer surface is stretched, and its inner surface is compressed or shrunken in length, while about half way between the outer and inner surfaces is a layer of fibres which are neither stretched nor shrunken. This may be called the neutral layer. An approximate rule, that is more correct in some cases than the one just cited, assumes that the straight parts of a band or belt run with the same speed as the neutral layer, and that, no matter how much the band or belt is stretched, the neutral layer is still half way between the outer and inner surfaces. Whence the rule that the number of turns of the driver divided by that of the follower equals the sum of the diameter of the follower and the thickness of the band or belt, divided by the sum of the diameter of the driver and the thickness of the band or belt.

When the elasticity of the band or belt is taken account of,

the resulting rule becomes more complicated. If two lines be drawn across the inner surface of an elastic belt, square with the length of the belt and near to one another, these lines will be nearer to one another when they are both on the slack side, than when they are both on the tight side of the belt. For the slack side, being under less tension than the tight side, shortens on account of the elasticity of the belt. When the two lines touch the face of either pulley, their distance apart is least when they are nearest to the slack side of the belt. The belt then creeps on the surfaces of the pulleys, and produces that polishing of the faces that has been observed so often. It is evident that the belt creeps *backward* upon the surface of the driver, and *forward* upon the surface of the follower, in both cases toward the tight side of the belt; and we may conclude that, on account of this creeping, the surface of the driver gains a little upon that of the belt, while the surface of the belt gains a little upon that of the follower; still more, then, does the surface of the driver gain on that of the follower.

But there is still another way in which the elasticity of the belt enables the driver to gain upon the follower. The friction between the pulleys and the belt hinders the belt, to some extent, from shrinking upon the driver, and from stretching upon the follower. It results that the same portion of the belt will measure a longer distance upon the face of the driver than upon the face of the follower, or that the driver must turn more times than the follower to carry the belt around.

Then both the elasticity and the degree of tension of a band or belt affect the ratio of the number of turns of the driver to that of the follower; and if any two spindles of a ring-frame make *exactly* the same number of turns per minute, it is only by a strange coincidence that they do so.

Mr. ATKINSON. In considering the effect of the first starting of the frames in the morning, I have assumed, that, if the spindles stick from the chilling or want of fluidity in the oil, the strain will come upon the band next the wheel, and the whole power will be concentrated on one side of the band, which, if then damp, will be at once stretched to its utmost.

Mr. DRAPER. I have been requested to make the following motion, which I do now make: that, in order to meet the expenses of the coming year, the Board of Government be, and they hereby are, authorized to lay such an assessment upon the

members of the Association as in their opinion is required, not exceeding in amount ten dollars, as limited by the by-laws.

This motion was carried without dissent.

Mr. DRAPER. This matter of banding spinning-frames as a practical thing has been forced upon me, and I have given it as much attention for the last ten or twelve years, perhaps, as any other man. I have had a very deep interest in it, and as far back as seven or eight years ago, being greatly perplexed with the contradictory tests of the dynamometer with regard to the different spindles, I made up my mind that it was just as utterly impossible to compare one with another from any tests we could get, without knowing the tension of the bands, as it would be to try that friction-machine by the different results which have been set out here. In fact, taking a Sawyer spindle-frame, and banding it one way and banding it as it was banded in the mill where it was found, it would vary thirty-six per cent in the power required to drive the spindles. Now, I said seven years ago, I was going to find out some way to ascertain the tension of the bands. I have asked a great many men here, and a great many elsewhere, "How much lateral pull is there to the band in the spinning-frame? How much in your practice?" I never found one who would make an estimate. One of my sons had been to the School of Technology here, and I thought I would give him a practical question. So I said to him, "There is some way by which we can ascertain the tension of bands; I want you to find it out." He went to work and took a bolster and step out of a frame, drilled a hole through the spindle above, put a wire through the spindle, and then applied a spring-balance to bring it to the point where it belonged. That was a practical test. Then we tied the bands with different tensions, and we very soon found that the difference in the different bands was simply astounding. I thought the matter over, talked about it, and finally Mr. Sawyer, the inventor of the Sawyer spindle, taking that idea, went to work and constructed something by which you can ascertain the tension of every band on each frame in a few minutes; ascertain it just as well as you can weigh a pound of butter. It is to have that whorl [exhibiting an implement] fixed the size of the whorl on the frame, and slip the band off; put this straddle of the spindle and slip the band on this whorl, and then pull on this scale until the sides of the whorl are together, just the same as when you weigh with

steelyards; you look and see that your beams are even, and, when you have done that, here is a spring-balance attached. And, by the way, we have thought it worth while to patent it. [Laughter.] You don't use any thing that is not patented; you won't even copy it. Now, then, you can just look on that index, and see the tension of those bands. Now, it has been found, on careful examination, and sworn to by two persons, that a frame of ordinary spindles in one of the best mills in New England had bands upon it that were pulling all the way from one to sixteen pounds. What do you think of a difference of sixteen hundred per cent? We have found, within a few weeks, Sawyer spindles banded with twelve pounds side-pull to a spindle. Now, to have an average, we had an engineer go and test a frame with the old form of Rabbeth spindle. The frame was taken just as it had been running, and it was running first rate, apparently. That frame was tested, and the pull of the bands averaged only two and a half pounds. Now, is that too much or too little? That is the question. If it is enough, you don't want five pounds, nor six, nor eight. If that is enough, you don't want any more. He tested that frame, and the result of it was he had sixty-five hundred turns of the spindle (I think one hundred and forty-two spindles, or upwards) to the horse-power, — somewhere in that neighborhood. He went to another mill, within a fortnight after that, where he tested the bands, and found the average on a Rabbeth spindle 4.80 pounds, I think it was. Now, I don't believe that is what you want. I don't believe you know where you are. I have said for years, that, where you have twenty thousand spindles, you could afford to pay a man five dollars a day, if he would only regulate your bands. You would save power enough in a steam-mill to pay for it, to say nothing about wear and tear. The loss is perfectly enormous by the amount of power that is wasted, and the amount of wear and tear. And in addition to that is the great amount of banding wasted, where you have eight, ten, fifteen, or sixteen-pounds of side-pull, where you need but three. We went to one mill, where some of the spindles had been run twenty-two years, and you would not have known but that they were new, as far as wear was concerned. We did not find any band pulling over three pounds. The mill is making as much yarn, and as good, as any mill, and the manufacturer is getting his yarn, number twenty-nine and a half, spooled at less than

one-third of a cent a pound. If that amount of pull will produce such a result, you may be sure that that is the limit of what you want. We have found the average somewhere from three to five pounds.

Now, on this same line we have gone a step further. Seeing this thing, my son conceived the idea that, taking this plan, you can just as well tie on the bands, and know just how tight you are going to tie them. We have made an instrument, and tested it, and are satisfied that by putting that on, which is an easy thing to do, it is not going to hinder much of any. You can just draw these whorls up until the edges come even, and have the amount fixed at three pounds, or two and a half, or wherever you find it is necessary, and have all your bands tight, and pressing alike.

I have heard people say they could tell when their yarn was strong enough, without breaking it; they could tell by feeling of it; and a few years ago most of our best mills did not know the strength of their yarn. They might as well say that they could tell how many cords of wood they had, without measuring it. I tell you, gentlemen, that, with such an easy and cheap way as you have of measuring the pull of your bands, you cannot afford to waste the power, and suffer all the evil consequences that are coming from it, by having them all the way from one or two up to ten, twelve, fifteen, or sixteen pounds.

At this point, the hour for recess having arrived, Mr. Draper suspended his remarks, and a recess was taken until two o'clock.

AFTERNOON SESSION.

The convention re-assembled soon after two o'clock, Vice-President Cumnock in the chair.

Mr. DRAPER. If there are any gentlemen here who are interested in seeing a new plan for putting on bands of the same tension, I should be very happy to show it to them. It is a simple thing, and I do not think you would want to be without it. The idea of it is, — here is an implement to slip right on to three spindles, we will say, right above the whorls. There is a whorl that comes to the middle spindle that we want to tie the band to, — a false whorl, that can go up, we will say, a quarter of an inch beyond the centre of the spindle, if you please, so that it will not bear against it. Then there is a chance to regulate the tension of this with a spring, so that,

when you tie it up until the edge of this false whorl comes even with the other, you have got what the tension would be on the other whorl. Then you slip it right off from this whorl on to the other. I do not think it would cost any more to put the bands on to a mill in that way, than it does to put them on in the ordinary method; and, after you had got them on, they would be worth a great many times more. Mr. Weeks, of the Lancaster mills, has just informed me that he took one of these implements for the purpose of ascertaining the tension of bands home with him. He has Sawyer's spindles throughout, in two different mills; there are some twenty thousand of them, more or less. In one of his rooms, I understood him to say (if I am not right, he will correct me) he found no band of over two and a half pounds tension, and he found some bands with half a pound tension. He went to the other mill, and he found one band with as low as a quarter of a pound tension, and others with five pounds tension, the five pounds tension being invariably where they had put on new bands. And he further says that neither the half-pound pull, nor the quarter-pound pull, made slack yarn. Now, it is not worth while to be so much afraid of slack yarn, that you waste more power than would pay for any amount of it.

I do not feel that I ought to take up any more time now. I have only this to say: I think I can indorse what Mr. Woodbury said in regard to the extremes of banding on the same kind of spindles; and I believe the extreme difference of banding will make more difference in your power than there is between any of the different spindles, at the same speed. But do not jump to the conclusion that there is no difference in spindles on that account, because, if an improperly banded Sawyer spindle will run heavily, an improperly banded large spindle will run as much heavier. I said here a good many years ago, when I was first about introducing the Sawyer spindle, that people could afford to pay twenty-five cents apiece for the poorest bobbins to burn, rather than use them. I know I met the objection almost everywhere, that the Sawyer spindle would not bear a poor bobbin; whereas they could use any bobbins for the other spindles, and they would be all right. Now the fact is, that the Sawyer spindle will carry a poor bobbin better than any of them; but you cannot afford to put them on. Suppose we wanted to increase the speed

of the Sawyer spindle from six thousand to seventy-five hundred: as the centrifugal force is as the square of the velocity, while a poor bobbin might run reasonably well at sixty-five hundred, it would do very much harm on the same spindle at seventy-five hundred. In my experience of forty years, I have never known of any way by which we could determine precisely how tight our bands were. Having discovered this method, and made it known to you, I have no doubt you will profit by it.

Mr. ATKINSON. I should like to call attention to one other matter in this connection. I told Mr. Draper that we should pass a vote of distrust on all his patents at this meeting, if he did not find some good mechanical method of joining the ends of bands, and asked him if they could not be clamped like the wires of a woman's hoop-skirt, and, if they could be clamped, if he could not devise a method that would clamp them after they had been drawn to a uniform tension. He has here the bands that are clamped like the wires of a hoop-skirt; and we will postpone the vote of censure until the next meeting, in the expectation that he will bring an instrument by which that joining can be made under an absolutely uniform tension, if he has not got it already.

I will state to you, also, that I have seen within a week, and hoped to see here, an endless band without any knot or clamp at all, which the party who has it thinks he can make successfully. I hope he can. He is a man skilful enough to do any thing he undertakes.

A MEMBER. I hope he will tell us how to put it on.

Mr. ATKINSON. That will be part of it.

A MEMBER. And how to tighten it.

Mr. ATKINSON. If the members of this Association are not equal to any problem submitted to them, they are not the men I take them for.

NOTE. — Since the meeting our Mr. Woodbury has found a band in use in a woollen factory at Oswego Falls, which is made by S. Rowbottom, Meadow Mill, Glossop, near Manchester, Eng., in which the knot is avoided, and the fastening is compassed by a metal link of one-sixteenth-inch wire. The bands are made of twisted cotton, with a loop at each end; the wire link is inserted in the form of a figure 3, and pinched to the form of a figure 8. Mr. Woodbury was attracted by the great steadiness of the spindles, and was assured by Mr. David Ramsden, the agent, that it was mainly due to the mode of fastening of the bands, and that these bands wear twice or three times as long as those knotted in the usual way. Samples may be seen at our office.

Mr. DRAPER. I only want to say one thing that I omitted, because Mr. Atkinson likes to have people criticise his way somewhat. There is one thing in that problem, the weighting of bands, which is different from what it is in actual use, and that is (I presume it may have occurred to you all), if the band shrinks at all, it must shrink against the full pressure of that weight. Now, then, in the spinning-frame the problem is different. When a band stretches there, it is not so tight. If it stretches in this experiment, it will be the same as if the spindle was moved away from the cylinder, just as much as the weight is moved away. There is that difference in this matter.

One thing occurs to me that I think is exceedingly important in connection with this question about starting up. There are people here who know that the coefficient of friction with continuous lubrication is very different from what it is with intermittent lubrication. Now, you start an upright bearing such as we have in ordinary spindles, and all the horizontal bearings, hundreds of bearings in a spinning-frame, that had stood from Saturday night until Monday morning (and perhaps they let them run longer Saturdays, without oiling, than they do any other day), and you find on top of the whorls the oil that should be in the bolsters; and, that having all run out, the frame starts without the proper lubrication, and especially without any proper distribution of it. That is one of the great elements of this starting up hard, as well as the question of warmth.

Mr. WOODBURY. I would remind the gentleman, who raised the question of the difference of condition between the bands I described and those in use in practice, of the fact that I had the lightest weight for the band to pull up that I could use. A quarter-pound weight was just light enough to pull the band up, and to start, so that I should have, as I believe I mentioned, the friction of motion and not the friction of repose. I repeated the test quite a number of times a day, so that the bands should be perfectly free to contract; and when they did contract they were not obliged to lift weights, because I lifted them from time to time, perhaps twice an hour. As I was at work in the room there, I had an opportunity to do so.

Mr. ATKINSON. Of course the difference in condition is admitted as inevitable. We only approach as near as we can, by

the extension of a straight band, to the conditions of a spindle-band and give the results for what they are worth.

I would like to call attention to this drawing of a lubricating machine, or frictional machine, that has been designed by our Mr. William B. Whiting, and drawn by Mr. William H. H. Whiting, to meet some of the alleged requirements, and to get nearer the scientific points than we have yet reached with the other machines. The object of this machine is to get a cone-bearing with a groove under it, as drawn by Professor Ordway; it being the intention to rifle the cone in such grooves as will secure an even distribution of the oil that may be placed in the cup. And attached thereto is a dynamometer to measure the power, and a place for a thermometer to be inserted where there will be no air-chamber, and nothing but a thin film of metal between the surfaces that are revolving and the parts of the machine itself. This machine, if constructed at all, will be constructed as nearly as possible in an isolated way, so that we may get as near to the scientific necessity of isolating the machine, or the parts of the machine, as possible. That will be rather an expensive machine to build, and we are now coming to a pause to see where we stand on the money question. I think we can carry it out.

I would also say, that the dynamometers that have been tried have not been sufficiently accurate for the very small force required for a twenty-four spindle-frame. We have also had a machine designed of that sort, which Brown and Sharpe will build, if we ask them to, for about three hundred dollars. But we hesitate yet, in order to get the absolute conditions of the problem, before we proceed to expend quite so much money. We want suggestions on that.

Mr. DRAPER. In listening this morning to the remarks of Professor Ordway in regard to the nature of the metals to be used, it occurred to me — although I am not personally familiar with it — that what is called phosphor bronze would be the very best thing that could be obtained. It is claimed for it that it has been used for boxes for cars in England for years; and when the sediment was washed off, the dirt, &c., they could not see that it had lost any thing: it seemed to be absolutely impervious to wear. There is an agent for it in Philadelphia with whom I am acquainted, and it is being used in certain places on machinery in England, where they tell almost fabulous stories about it in that respect.

Mr. ATKINSON. That subject has not escaped us, and one of our students at the Institute was requested to investigate it on a late visit to Europe. We have been considering the question of the use of phosphor bronze, not only in this, but in many other important places; for we think we are behind the old country in the application of phosphor bronze for many important purposes.

Mr. GOULDING. I would like to inquire of Mr. Atkinson, if, in order to test the lubricating qualities of oil, it is necessary that we should have metallic bearings on both sides.

Mr. ATKINSON. I am not competent to answer that question, sir.

Mr. GOULDING. I asked the question in view of a suggestion that occurred to me this morning, when we were talking about this matter of means for testing the lubricating qualities of oil. An idea ran through my head, which I would like to put upon the blackboard, in regard to a method of getting at the lubricating qualities of oil without the use of expensive machinery. The disposition of the Yankee nation is to get things simply, and without great cost. Suppose this to represent a pan or dish filled with oil up to a certain point. Above here we will put a bearing, properly supported, and driven from above by any apparatus that will effect the purpose; and we will have a dynamometer to test the power necessary. On this oil let us place a metal disk, if you please, that floats upon the surface. We put a certain quantity of oil in here, and let that disk lie on there, with a certain weight attached to it, and that weight is uniform. Now, the application of power there, with a dynamometer apparatus to test the power necessary to run that disk on the surface of the oil, is what occurred to me as being a method of testing the frictional qualities of oil.

Mr. ATKINSON. You mean, a contact of the metal surfaces on the oil alone?

Mr. GOULDING. On the oil only.

Mr. ATKINSON. I do not know, sir.

Mr. GOULDING. It is quite possible that this disk, instead of being metal, should be wood, so that it would float. The floating qualities would be uniform.

Mr. DRAPER. How are you going to keep the other bearings uniform?

Mr. GOULDING. The same as you do with the Sawyer spin-

dle. There can be no more difficulty in keeping the friction uniform on that bearing, than on the other bearings in the machinery.

Mr. DRAPER. That is the very difficulty they have.

Mr. GOULDING. If there is nothing further to be said upon this subject, I would like to say that I regretted this morning, when the subject of legislation in New York in respect to tare on cotton was mentioned, that more was not said upon that subject. I was waiting for some one older, and better posted on these matters than myself, to say more upon it. I think that the subject of tare on cotton is one of great importance. The State of New York, through its Legislature, has seen fit to take the matter up, and, as I understand the position of the thing, a bill to regulate it passed to its third reading with very little opposition; but whether it finally passed, or not, I do not know.

To my mind, now that the margin for profit in manufacturing cotton goods especially has been reduced to so narrow a limit, and will probably continue so, this matter of the tare on cotton is an important subject to us; and men like yourself, Mr. President, and myself, who are lying awake nights to find some cheaper method of manufacture, and to reduce expenses in every possible direction, are interested especially in not paying from ten to twelve cents a pound for bagging and hoops. Even if in the outset — which would probably be the natural result of such a change — there should be an advance in the price of cotton, to cover the deficiency which would arise on account of the planter not getting twelve cents a pound for his bags and hoops, it is a thing which would ultimately rectify itself, and must in the end result in the advantage to us of buying cotton, and not bagging and hoops, at ten or twelve cents a pound; and I wish as many gentlemen here present as are interested in this subject would express their views upon it. When this matter has been up before, it has been urged, and it struck me very forcibly, that it was not, perhaps, in our line, as agents of mills, to move in this matter, because, as a rule, the treasurers, I believe, buy the cotton, — mine does, anyway. But at present I am instructed by my treasurer to introduce this subject, and urge it to some conclusion; and it has occurred to me that a committee should be appointed at this meeting, perhaps, who would report at our next meeting some method by which effi-

cient steps can be taken to change the present method of buying cotton in relation to the tare, with a view, after our next meeting in October, perhaps, if it is within the province of the Massachusetts Legislature to regulate these things, to move on the Legislature at its next session. And, in order to bring the matter before the meeting for discussion in proper form, I would move that a committee of three be appointed, with a view to report at our next meeting upon some method of action in this matter.

Mr. DRAPER. I make the inquiry whether this matter has been before the National Board of Trade or not, or whether you cannot get it there.

The PRESIDENT. I see Mr. B. F. Nourse present, who is a large cotton-buyer, and who perhaps can give us some information on the subject.

Mr. NOURSE. A few years ago there was an association called the National Association of Cotton Manufacturers and Planters, which existed from about 1866 to 1870. That body had this subject of tare on cotton before them at several successive sessions. One report was made in favor of asking the Legislatures of the several States, through whom alone action could be had upon it practically, to pass laws regulating this matter. That report, after discussion, was referred back to the same committee for further consideration; but the committee made no further report.

I think the inherent difficulty in dealing with the subject here is, that it is impossible for the Legislature of the State of New York, although containing within its jurisdiction the largest cotton-market we have in the country, in extent of transactions, nor the Legislature of the State of Massachusetts, to pass laws that shall have any influence whatsoever upon the price or cost of cotton. Indeed, I am inclined to think, after examination of this subject for a good many years, that, as a matter of dollars and cents to American spinners, the present position is better for them than it would be if they bought their cotton at net weight, with the consent, approval, and under the authority of the Legislatures of every one of the cotton-growing States; and I will try to give briefly the reasons why it is so.

All the gentlemen here present know this fact, and it needs no illustration of itself, that if two-thirds of the production of

the looms of the United States was exported, as in England, the price of the exported portion would most surely control the price of the one-third that remained in the country for domestic consumption and use. In other words, it is the exported portion, in such case, that will make the home price for the whole. Now, apply the same to the cotton. The cotton-crop this year is in the neighborhood of 5,100,000 bales. A little more than two-thirds of that will have been exported at the end of the season. Supposing we retain from 1,550,000 to 1,600,000 bales in this country: to a merchant, it is evident that on any given day, or range of days, the price at which the exported portion of middling cotton is fixed will be the price, controlled by the export, of that which remains. That is, in the export of that portion, the price will be fixed for that which remains. If the Legislature of New York should pass the act, as demanded by the petitioners to the Legislature, establishing a law of actual or an arbitrary tare (and an arbitrary tare should be that which is the usual and customary tare allowed on exported cotton, say six per cent), the Southern markets retaining their present custom of selling at gross weights, the customer has his choice then to buy in Savannah, or to buy the upland cotton in New York. In Savannah, the price, we will say, is sixpence farthing per pound free on board, with freight and six per cent; that six per cent being deducted from cost for the present custom of gross weights. The limit at New York would be sixpence farthing per pound free on board, with freight, without the six per cent, because the cost is identically the same. In either case it is the cost at Liverpool, to which only insurance is to be added; every thing else included in the limit. That is precisely the custom to-day. Now, it is very evident, that if all the markets North and South should fix an arbitrary tare of six per cent for bagging and bands, and the cotton should be bought in that way, the price would rise in this country just so much — that is, six per cent — as the tare was taken off. The cost to the consumer in Liverpool would be exactly as it is now, only the tare would be taken off on this side instead of on the other.

The common impression is that the European spinner gets his cotton, less tare. So he does, but it is with so much price added; for, if the tare was deducted here, he would have to pay just so much more price for it. As the English spinner

gets his cotton, so we get ours. His buyer buys at gross weights, but he invoices it with six per cent off, to reach the necessary limit of cost. Necessarily, all the cotton retained in America bears its proper relation to the price at Liverpool, or, say, the general market of Europe, as adjusted in this way.

Perhaps I fail to make myself clear in the matter; but there is a level, at any given time, which we may call the commercial level of prices, disregarding the temporary fluctuations and irregularities of local markets.

Now, there is a further fact. All you practical gentlemen will probably bear out the statement, that bagging and bands very seldom reach five per cent of the weight of your cotton. You are buying it at a price, tare on, as if it were six. To that extent you are therefore saving, in comparison with the actual tare. It has been impossible to imbue the legislative mind, in any one of the cotton States, with any other idea than this: that, if the actual tare was taken off, they would lose just so much. We could not persuade them that they would get, in selling to Englishmen, a little more in price than they took off in tare. And a corresponding error has generally prevailed here in New England, that the mills are losing the five or six per cent of tare which they find on the cotton. It would be so if there were no regulator to take it off in the price when the cotton was bought. But the great regulator of the price of the exported portion adjusts that for you, and makes the cost to the New England spinner. That is, the cost to you is precisely the same as it is to the English or German spinner, except difference in transportation. There is no difference between them, — one of them getting the allowance in tare; the other, in price.

It is impossible to enact tare laws, except through a union of the Legislatures of the several States, by persuading the Legislatures of the several cotton-growing States that it is for their interest, the interest of their people, to do so; without that persuasion, they certainly will not do it.

Mr. ATKINSON. I certainly think that a committee had better be appointed. It fell to me several years ago to investigate this subject. I therefore took the price of middling cotton, as quoted in Liverpool and as quoted in New York, on even dates, four times a month, through a series of years. I converted the Liverpool price into currency, making allowance

for the difference between gold and currency on each specific date: then, deducting from the Liverpool price the six per cent of tare, I had the comparative price paid in New York and the comparative price paid in Liverpool for the same quantity of clean cotton, and I found that the average difference in our favor, and against Liverpool, was, as I recollect, six-tenths of one cent a pound; which represents three thousand miles of distance, and the cost of loading on board ship. That analysis covered a sufficiently long period of even dates to prove the point. I think Mr. Nourse's position is rightly taken, and that any interference with this matter by law, in any particular State, will only throw the cotton-market away from that State into the others that do not attempt legislative interference. Your remedy for this difficulty is to come, in the slow course of time, in the spread of intelligence, and the application of better methods to the treatment of cotton between the field and the factory, on which we have sometimes had discussion. It is at present as barbarous as may be, both in respect to the nature of the saw-gin, and the nature of many of the processes through which the cotton is passed. There is progress in that direction. The trash-cleaning machine, which was brought by diagram before this Association two or three years ago, has been perfected and improved, and is at work in Texas, and is delivering cleaner and better cotton; and, as far as that goes, a method has been devised of getting the dirt out of the cotton while it is still attached to the seed, and the seed has dead weight sufficient to carry it away from the dirt. Other machines of the same character are being perfected. In short, there is the same improvement going on in the methods of treatment of cotton that there is in the methods of Southern life. You will get your results ultimately; but you cannot hasten them by the action of specific States, in my judgment.

Mr. PAINE. The suggestion made by Mr. Atkinson in regard to the improvements, it seems to me, covers the whole ground of cotton, whether it is exported cotton, or cotton used in this country; and we welcome any improvements that may give us all an advantage. But it seems to me that the question before us has a different bearing. I agree with the gentleman who first spoke (Mr. Nourse), in regard to the improbability of making State legislation bear upon this subject; for we know that it would be almost impossible to get an united South upon

a question of this kind, and we have seen in the State of New York, when once brought to the point, a rebellion rising in the city of New York among the cotton-trade: so that it seems impossible for us to reach the difficulty at that point by legislation. But it does appear to me that the question is of moment enough for us to pursue it with the idea of accomplishing the object; and it appears to me that the only way we can reach it is through our cotton-exchanges.

Now, in regard to the matter of our receiving no benefit, I somewhat disagree with the gentleman who spoke, although my experience, of course, is very much less than his. But, in regard to the matter of price, we all know that the cotton that is exported from this country is not all ordered by the spinner: it is exported by speculators and middlemen, who sell to the spinner, and the spinner has the advantage of this six per cent from the price, which we do not have. In regard to the price, we find that a variation occurs sometimes. We find that the Liverpool market is to-day nearly a cent a pound higher than the New York quotations for middling upland. There have been times, within the last two months, when the reverse was the case; when New York was higher than Liverpool. The price is governed by the demand and the supply at the spot. It seems to me that if we are able to have this practice universally adopted in this country, we, as spinners, will be placed on the same level with the spinners abroad; and, as the question of exporting goods is coming largely to our attention, it seems to me that this is another reason why we should press this matter for our own benefit. The foreign spinner, as I say, gets the benefit of this six per cent, regardless of prices; for prices are governed in that market by supply and demand, as they are here. It is soon lost sight of, even as the tax was in the time of the war. The tax on cotton was lost sight of in the price; and so we shall find here, if the system is adopted of taking the tare from the cotton universally at the Southern port, that we are placed on the same level with the foreign spinner in regard to tare. As to the matter of the tare not being equal to six per cent, perhaps it may not be in some instances, because our bales are larger than formerly; but if we get bales, as we do sometimes, running from four hundred to four hundred and fifty pounds, I think the tare will very quickly then reach six per cent. If you get large bales, your

[illegible]

[illegible] ... New England ... [illegible] committee.

Mr. [illegible] I was not understood. In describing a [illegible] between the price of the cotton retained at home and the price of the cotton for export, I was taking the price in this country [illegible]. The price in Liverpool or Havre [illegible] having nothing to do with it, except as the price of cotton there determines the limit that should be [illegible] in this country. I sought to make it understood that the price of cotton exported was fixed at the time of its purchase, and it was in the relation between those [illegible] in this country, and elsewhere, that this equal[illegible] for any given time or place. I should leave out of account fluctuations and irregularities in the market, in [illegible] which have no bearing upon [illegible] question. If we were to take into account the relation of prices in New York and Liverpool, it is true that the English [illegible] who has taken his cotton in Liverpool as wanted for use, and has not imported it himself, in the last four years, has bought his cotton actually half a penny a pound lower for [illegible] of those years, and a penny a pound for the other two, in the average of the season, than he would if he had imported or had taken it in large quantities, as it is usually taken in this country, because we have had four years of extraordinary fall in prices; in two of them a penny a pound from the opening

of one season to the opening of the next; in another one about three farthings, and in another one a farthing. Now our prices stand just about the same as a year ago. The gentleman refers to the quotations to-day. I think he is mistaken as to a difference of a penny a pound between Liverpool and New York. To-day the price is sixpence farthing for middling, and that just represents the price in New York, eleven and a half cents, because the expenses, and difference in the tare, would make that good. There is where tare comes in. You must add it to the New York price, or take it from the Liverpool price, as you please.

Now, Mr. Chairman, one word of excuse. It is only of the courtesy of the Association, in electing me an honorary member, that I have standing here at all; and it is only upon your call that I take part in the debate. I hope, however, that this subject will be treated fully and thoroughly by the committee which it is proposed to elect.

Mr. GARSED. I had something to do with the meeting or meetings of the cotton manufacturers and planters, to which reference has been made by Mr. Nourse. This subject was before that association upon three or four occasions; and, so far as my understanding of the matter went, the change was urged upon the ground that the American manufacturer did not stand upon the same footing as the Liverpool buyer of cotton. If it is proper to allow a tare of any amount in Liverpool, and no injustice is done, why should it not be universal? Why should we see the cotton-dealers of the city of New York rising up in arms against this law which has been proposed in the Legislature of New York? I do not pretend to say whether it will be effectual or otherwise; but why the opposition?

Now, if I understand the custom in Liverpool, and I think I do, where there is a dispute as to the tare upon cotton, whether it arises from mud or excessive hoops or excessive cloth, as we often have it, or where, perhaps, they do not take the trouble to take off one covering of cloth before putting another on, we have no chance of reclamation: there is no tribunal to which we can appeal. But, if I am correct, in Liverpool a given number of bales are stripped, and the settlement is made, upon the actual tare found upon that number of bales of cotton. Now, if that is the case, why do we not have the tare fixed, when all hands agree, at five or six per cent, and, when there is

a doubt, strip the bales and give us the actual tare, the same as is done in regard to a hundred other articles that are bought and sold in quantities, probably as valuable as cotton, — I mean in the aggregate amount, — as, for instance, sugar, molasses, hay, silk; and I might go on, and enumerate many others. There is probably no article of the magnitude of cotton that is so badly handled from the time it leaves the planter until it is in the hands of the manufacturer. I might speak of its being rolled in mud, laid out in the rain, handled by any man, I was going to say, who chooses to take a knife, and cut a bale and sample it. There is simply no rule of conduct, or of common honesty (I know it is a strong term), in regard to the matter of handling cotton, from the time it leaves the planter's wagon until we buy it. Now, I claim that if England has the six per cent, and it is admitted that we have our cotton just as cheap as they do, there ought to be a universal six per cent. Why not give it to us, and then let us fight the battle just as John Bull does? He won't buy cotton that has been dragged in all the mud from Arkansas to New York, and pay for mud as cotton; he insists upon a deduction, and he gets it, I am informed.

Now, I say that this Association ought to agitate this matter right upon its merits. If England is allowed six per cent (and of course Mr. Nourse's position is exactly right, that the price of cotton in this country is governed by the price of the cotton exported), why not put us all on the same footing? If there is no wrong in it, why not adopt it? But I complain more upon the subject of the manner of handling cotton, and no reclamation, than I do upon the five or six per cent which we know that the baling and the hoops or ropes come to. It is time that the subject was taken up intelligently and understandingly. I claim that cotton ought to be dealt with precisely the same as any other great staple. This argument that it is no use to try to do any thing is the argument which was used in 1866, I think it was, at the meeting of the Cotton Manufacturers' and Planters' Association in New York; but we know that the English manufacturer will not accept cotton that has got six per cent additional mud upon it, over and above his six per cent bagging and hoops.

Mr. CUMNOCK. Mr. Goulding makes a point on which I would like to say a word, as to this not being the proper body before which to bring this matter. Every mill-agent in New England

has cotton sent to him from Boston, or from whatever point it may be purchased at, and he starts in the first place with about five per cent of tare on hoops and bags, and with about two per cent additional for loss in weight from sand and other foreign substances; so that every mill-agent has to face a bale of cotton with seven per cent loss on it to begin with, to make cotton cloth, and then he is expected to send his cloth back to Boston, or wherever it is to be consigned, with a very low waste account. I think this is the place to bring this matter up. I do not know any class of men more affected by the loss of weight and tare on cotton than the mill-agent.

Mr. GARSED. There is one point upon which I think it may be just as well for an outsider like me to touch. I have heard the remark before in this room that the agents of the mills had nothing to do with buying cotton, but I think I can tell you where they are sufferers. If the treasurer of a mill buys cotton that has extra bagging or hoops upon it, or has additional dirt upon it, and it goes to the mill, it would seem that the agent of that mill, if he should make no dividends, would be blamed, and probably placed in a very unpleasant position, because he fails to make a profit where other mills are making one. But the trouble is, that the treasurer of his mill has sent cotton to him to spin which has not the stuff in it to spin, and make a profit. Therefore, it is the duty of the mill-agents, as represented in this Association, to insist that they know what they spin; for they have a reputation at stake.

Mr. GOULDING. I would like to correct myself, if I gave the impression that I thought this was not the proper place to introduce this subject. I did not mean to, — I introduced it because I thought it was the proper place. But, when the matter was first introduced here, the suggestion was made that we agents had nothing to do with buying cotton, and we could not do any thing; and I say that argument had some force with me at the time. But, on reflection, I have come to the conclusion that it is fallacious; that the treasurers, to a great extent, are under the influence of those gentlemen who sell cotton, and we are the real sufferers.

I was very happy to hear the remarks of the gentleman from Philadelphia. He strikes at the root of the matter. Why should not cotton be treated like every thing else that we buy? If we buy a barrel of kerosene oil, we measure it; and, if it falls

short, we go for the difference. So it is with coal, and all our supplies: we must be made whole. If we buy a hundred gallons, we must have a hundred gallons: we are not going to pay for a hundred gallons, and take ninety or ninety-five or ninety-eight. But on cotton, which is the article upon which we suffer the most, we have no reclamation. I have weighed a great many bales, with a view to inform myself on this subject. I will not undertake to give the figures, because I have not my memoranda with me; but the number of hoops, the weight of the bagging, and, as suggested by the gentleman from Philadelphia, the amount of mud or dirt that is often found on a bale of cotton, are surprising. If we accomplished nothing more, if we can teach the South, and the factors who handle the cotton between the field and the factory, to handle it more carefully, and give it to us in a clean and dry condition, we shall do a great deal. I am satisfied, from the course that this discussion has taken, that very many here are interested in this matter, and are ready to press it forward.

Mr. BARKER (of Lewiston). I was very much interested in the remarks of the gentleman from Philadelphia, Mr. Garsed. I think he has hit the nail on the head exactly. I can see no possible reason, and there is no good reason, why the manufacturers of the United States should not be put on the same footing precisely with the English manufacturers. I know by what I read in the papers, and hear from parties who belong on that side, that if they buy cotton that is loaded down with dirt, or over-weighted with ropes and bags, they do just what he has said they have done. A certain number of bales are stripped, fifty or a hundred bales, bags and ropes weighed, and the tare on the lot is determined according to that standard.

It has been said here, by my friend Mr. Goulding, that the agents of the mills in New England do not buy the cotton, and they do not; but we have a large influence in that direction. I apprehend, that, if the six or eight hundred agents that there must be in New England should set themselves at work to change this custom, they would accomplish something. We should certainly have their influence in that direction, if nothing more. And, in my judgment, the men who control the mills of New England have some influence in controlling the action of our treasurers in buying cotton. Hence I believe that there can nothing but good come from a committee that shall look

this matter up, and report at a future meeting; and I do believe, that, with persistent effort on the part of this Association, we can reform the abuse. It is an abuse that we would not stand in any other single instance. If we bought a forty-gallon barrel of oil, and found, when it came to us, that there were but thirty-eight or twenty-eight gallons in it, we would not have it: we would ship it back to the party of whom we purchased. And so it is with every thing else we buy, — coffee, sugar, meat, — every thing we eat and every thing we wear: we pay our money, and we expect to have full value. But suppose I go to Nashville, and buy a hundred bales of cotton. It is shipped to my mill, and I find it falls short five pounds, on the average, to the bale. Well, they say, unless it falls short six pounds, I have no right to make any reclamation. Six pounds, I believe, is the standard that has been adopted. Such a case has happened, and I wrote to the man of whom I bought (I had not paid the bill), and told him to take the cotton back, or I would send him my check for the bill, less the amount it fell short. He took the check. All this talk that we cannot get a reclamation is only talk. There is not a word of truth in it. I believe, that if the treasurers of the cotton-mills of New England would put their strength into this matter, and insist on having what they pay for, we would get it. Hence I am in favor of Mr. Goulding's motion, and hope it will pass.

Mr. Paine. There is one point raised by Mr. Barker that I am glad he has presented, for this reason. As I stated last fall, I have taken the ground this year that I would not buy cotton of any party who would not agree that in case the cotton fell short over five pounds per bale I could make reclamation. It is very difficult to bring the brokers into that arrangement. One broker, of whom I was buying largely, absolutely refused to agree to any thing of the kind. I told him, "Very well; that is my rule. If I buy any thing of you, that is my rule." Time passed along, and up to the 1st of March I had not bought any thing of that broker. He came along, and asked for an order. I told him, "There is my rule. Any thing over five pounds to a bale, I have the right to make reclamation. I have not given an order except on that condition, and if I give you one that is the rule." "Give me an order," he said. So it will be in every instance. If we will only take that ground, and stand firmly upon it, we shall get what we ought to have.

The motion for the appointment of a committee was carried, and the chair announced the committee as follows: Messrs. William F. Goulding, of Lewiston, Me.; Walter Paine, 3d, of Fall River, Mass.; Hervey Kent, of Exeter, N.H.

Mr. PAINE. I notice that Lowell is not represented on the committee, — a large market for cotton; and I think it would be well to have our friend from Philadelphia upon it, because it brings in an additional locality. I move that the committee be enlarged by the addition of the chairman (Mr. Cumnock) and Mr. Garsed.

This motion prevailed, and the gentlemen named were added to the committee.

Mr. ATKINSON. I have a few things here, which I think will interest you very much, and which I would like to get upon the record.

In connection with this subject of improvements in the treatment of cotton, I desire to call your attention to the treatment of cotton-seed by our friend Mr. Adamson, who once made us an address. I am sorry to see that I have but one sample; I thought I had two. The ordinary method of treating cotton-seed is to take off the hull, and burn or waste it, and extract the oil by pressing; the residue making that cake which is ground and fed to cattle or sheep. It is indigestible, as it contains still a good deal of oil. Mr. Adamson's process is to treat the kernel of the cotton-seed with naphtha, to save the naphtha with very slight waste, to take out every particle of oil there is in the seed, and to get a cotton-seed oil such as has been seldom seen, — fifteen per cent more oil than you can get by any other method. The remainder is then a white, light, sweet, digestible, and nutritious food for cattle or sheep. The day will come when wool and cotton will be alternated on the same field, fertilizing the field by the sheep as in England, doubling the crop of cotton, and adding the wool-clip thereto. Here is a sample of that food, and it is not unpleasant to the taste, although it leaves a little tang in the mouth. The hull, instead of being wasted, may be converted into nearly pure potash by calcination; it may be treated for the dyestuff that it has in it, for there is a great deal of tannic acid in it, and the residuum makes admirable paper-stock. As they use up the little end of the pig in treating hogs, they will use up the little end of the cotton-plant in treating cotton-seed; and

I do not hesitate to predict that the time will come within a few years, when the value of the twelve hundred pounds of seed, belonging to a bale of cotton of the average weight, will be half that of the bale, if it is not more nearly up to the full value of the bale; and, in the intelligence that will direct these new enterprises, you will gain a better treatment of the cotton and the cotton-fibre, that will result in benefit to this country as compared to the countries on the other side of the water.

The next subject, which interests you directly as cotton-spinners, we bring forward as underwriters. You are aware that in our mill insurance company we preach one-story mills. I am at liberty to bring before you a picture of a one-story factory, for which our Mr. William H. H. Whiting made the plans less than two years ago. It covers forty-five thousand feet of floor surface. It was built at a cost of about half a dollar a square foot. It is a story and a half practically; and under the floor, at every eight feet each way, is a pier. You therefore have no spring to the floor whatever, but you have the elasticity of timber under the support of your machinery. It is all shafted from below. It has monitor roofs, and the best of light. It has been in use during the last winter, with looms that were removed from the Renfrew mill. The same looms, to a considerable extent, are upon that floor, that were in the other factory of the ordinary construction on the second floors. The result of the change is this, — that the saving in gas, in running a thousand gingham-looms, requiring a large proportion of gas, as you are aware, has paid the interest on the cost of that building. There has not been the slightest difficulty in keeping it warm, with five rows of inch and a quarter pipe. On the morning of the night when the thermometer was fourteen degrees below zero, the thermometer in the mill was at sixty, the heat having been let on at midnight. The looms are run on that floor twelve per cent faster than they were run in the old mill; and it is proposed to build another mill of the same construction as this, next summer, and they will never again, if they have room, build a mill above one story high.

I will, with your leave, present for publication in the report the statistics of the yarn exports of Great Britain. The yarn export of Great Britain is gaining, while the goods export is

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losing. It is a simpler and less costly occupation than that of weaving, and one in which we ought to engage, but of which we as yet know but little. The time has not yet arrived, but the time will come, when we shall share in that yarn export, which constitutes one-fourth part in value of the exports of cotton-stuff from Great Britain.

I desire to call your attention next to these samples of wool, that have been treated in the course of our investigation of oils with naphtha. The time does not suffice to give the details, but they are very curious, of the differences in the treatment of wools from different regions; and there is here a chance for saving to a very great amount. Twenty per cent of the weight of the wool used in New England, and elsewhere in this country, consists of grease or oil, of a character more nearly like sperm oil in some of its peculiarities than any other. By successive methods, not apparently difficult, but which remain to be tested on a large scale, wools have been treated with naphthas, bringing out from the product a perfectly pure and very peculiar oil, perhaps the best for curing leather that has been found. There is a side of leather that has been cured with that oil. The currier stated that he had never had any oil better, if he had ever had any equal to it. That grease is now polluting all our rivers, and going to waste, to the extent of forty million pounds a year. The wool, after being treated in this manner, is simply washed in warm water, and brought to the condition of these samples. Here are samples of seven different kinds of wool, and I have a table of the results. There is a curious scientific value in this, and there must, in the nature of things, be an economic value, after it has been followed out to its conclusion on the basis of the trials that have been made in the laboratory. And this, gentlemen, is mainly woman's work, — the work of the skilful chemist who is teaching the woman's department of chemistry in the laboratory of this Institute.

The next subject, which I think may interest you, is the manufacture of rope from cotton and tar, of which I have some samples, made by Mr. Thomas Dunham. This rope will float, and not sink, and will, therefore, be of great value, if there are no outs about the process. I fear that Mr. Dunham has left the room; but I told him I would bring the matter before the Association as a new and very interesting product of cotton.

In connection with the one-story mill, a question of flooring, and the method of attachment of machinery, has arisen. On an inspection of a mill in Philadelphia — Mr. Thomas Dolan's mill — I found the basement concreted with a concrete that had been in the basement, used as a cloth-room, for three years. In that cloth-room his cases of heavy goods were loaded upon trucks, with iron wheels about an inch and a half in width; and those heavily-loaded iron trucks had been run over that concrete for three years, and his horses had been stamping on it in the stable for three years, and there was not a scratch to be seen. In this concrete, I understand, there is some asphaltum, which is a non-conductor of heat. It is, therefore, not liable to the difficulty of making cold feet.

The question of the right placing of machinery has been considered, and this device, which is Mr. William H. H. Whiting's, has been drawn, in case you should want to build a one-story mill with a concrete floor, when we get that start for which we have been so long waiting. There is a device of an iron rail in two parts, to be set in the concrete, with a pin to be dropped through the opening, — a wooden block to be interposed between the iron rail and the foot of the machine, whatever it may be, — and then set with a bolt and leather washer, so that there will be no contact of iron with iron, but there will be the elasticity of wood and leather interposed between the solid or rigid floor and the machine itself.

The last subject, to which I have to ask your attention, is a new watch-clock. There are several watch-clocks of great merit, all of which are satisfactory to us. But here is a watch-clock that we think your attention may well be called to. The wires from the several points are to be wound in one cable. We will suppose a watch-clock of eight stations: the eight wires are wound in one cable, so that there can be no method of connecting the wire in one room with the others, and thereby of sounding all the signals from a single point; but each signal-station must be visited, in order that it may be sounded; and then, if the watchman attempts to tamper with the clock, the moment he opens the door the fact is recorded that he has been to the clock, has opened the door, and has tried to tamper with it, and the exact hour is given at which he tried to do it. So that the clock not only protects the mill,

but protects itself, and is extremely simple in its adjustment. The name of the promotor of that clock is Mr. Adams, who is here to explain it to you, if you desire any explanation.

Mr. BARKER. About what is the cost of the clock and appliances?

Mr. ADAMS. We claim that it is the cheapest clock in the market. It is a very simple contrivance, and will not get out of order in any way. I have over four hundred statements from the best commercial houses in the city of Boston, representing forty millions of property, that are visited every night by our patrol. The cost is $125 for eight stations, including putting up and every thing, and $200 for sixteen stations. It can be maintained for five dollars a year.

Mr. MOREHEAD. For the purpose of answering the inquiry of Mr. Atkinson as to the starch-producing properties of the sweet potato, I have here papers from, and speak by authority of, Col. L. L. Polk, commissioner of agriculture, and Professor A. L. Ladoux, chemist in charge of State Experimental Station. One hundred pounds of white or Irish potatoes give $15\frac{34}{100}$ pounds of starch; 100 pounds of sweet potatoes produce $15\frac{6}{100}$ pounds of starch, and $6\frac{56}{100}$ pounds of glucose. Before the Irish-potato starch is used, artificially prepared glucose is added.

Should a process be found, as suggested by Professor Ladoux, for simultaneously extracting the starch and glucose, the advantage would be with the sweet potato, by all odds.

The capacity for production in North Carolina, Virginia, and South Carolina is practically without limit, at a very low cost per bushel, whilst the means of collecting and transporting potatoes, in North Carolina, is remarkable for the extent, efficiency, and cheapness.

There are more than ten million acres in North Carolina, especially adapted to this special crop. North Carolina has three hundred miles of sea-front, with three thousand square miles of inland, navigable, tidal water, in long, narrow strips formed by seventeen rivers and creeks, expanding gradually into sounds. There are five hundred thousand acres on the twelve hundred lineal miles of inland navigation, from which the potato can literally be shovelled into the hold of the vessel at the end of the row; and upon each of these five hundred thousand acres a crop of five hundred bushels of potatoes is neither impossible nor unattainable nor unusual, in a very lim-

ited way, now. There are eleven counties now reporting from four hundred to six hundred and seventy bushels, as the yield of an acre, — say two hundred as an average for a large acreage.

These waters are filled with little vessels called corn-crackers, manned by three men, and carrying from two to four thousand bushels of corn, and are poled where the stream is too narrow to sail. A steam-tug should tow them when filled and collected.

The cultivation of the light, sandy soil is easy: two men and one mule can cultivate fifty acres, provided they have sufficient help to set out the slips, when the showers come in the spring. The gathering-season, or harvest, lasts for six weeks, beginning the first of September and lasting until the first frost, which is generally about the middle or end of October.

The sweet potato can be kept in large bulks (if a warm sweat is allowed to pass off, and precaution against freezing is taken) during the entire year, or until late in May and June.

They are now piled in the field where they were grown, with pine straw, and leaves, and then dirt, thrown over them, with a wisp of straw in top.

This potato can be raised for less than fifteen cents per bushel.

Mr. ATKINSON. I will state that there are two or three gentlemen who have been attracted by the quality of the sweet potato as a starch-producer: not only Mr. Morehead, but one or two others, are moving in the matter.

Adjourned.

Measurements of Textile Bands under Constant Tension of Two and a Quarter Pounds.

1879.		Atmosphere.				Cotton Braided Banding.						
Date.		Temperature, Degree.	Relative Humidity.	Vapor Tension, In. of Mercury.	Water per c. foot, Grains.	Linen Core.	Worsted Core.	Cable, no treatment.	Braided, no treatment.	Treated with Naphtha.	Treated with Paraffine.	Made into Parchment.
Months.	Days.											
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
						Percentage of Increase in Length.						
January,	2	63.0	.43	.27	2.98	.18	.32	.45	.54	.54	1.72	.83
	3	59.5	.31	.16	1.85	.35	.20	.63	.78	.80	2.12	1.21
	4	61.8	.35	.19	2.27	.38	.25	.78	.86	.79	2.10	1.30
	6	67.2	.36	.26	2.99	.30	.31	.75	.87	.87	2.06	1.33
	7	69.6	.36	.26	3.04	.35	.28	.80	.90	.90	2.28	1.40
	8	65.4	.36	.23	2.66	.30	.31	.80	.90	.90	2.70	1.40
	9	55.6	.55	.24	2.79	.12	.47	.75	.81	.81	3.03	1.40
	10	70.0	.37	.28	3.18	.34	.35	.98	1.08	1.06	2.69	1.67
	11	69.0	.35	.25	3.22	.38	.37	1.03	1.15	1.08	2.87	1.76
	13	69.0	.42	.30	3.46	.31	.40	1.03	1.14	1.07	3.09	1.79
	14	68.3	.40	.28	3.23	.41	.42	1.00	1.14	1.05	3.47	1.80
	15	69.3	.33	.23	2.70	.39	.37	1.08	1.19	1.13	3.40	1.90
	16	67.0	.32	.21	2.40	.40	.34	1.12	1.23	1.17	3.54	1.90
	17	75.0	.29	.26	2.93	.43	.38	1.06	1.22	1.16	3.41	1.95
	18	70.7	.35	.31	3.57	.36	.46	1.06	1.22	1.13	3.55	1.90
	20	69.0	.44	.31	3.99	.31	.48	1.05	1.18	1.12	3.70	1.93
	21	63.5	.37	.22	2.54	.44	.37	1.14	1.28	1.17	3.94	2.00
	22	61.6	.44	.24	2.80	.39	.48	1.16	1.28	1.21	4.08	2.01
	23	73.2	.72	.59	6.55	—.07	1.01	1.43	1.47	1.27	3.79	2 42
	24	67.0	.46	.30	3.43	.40	1.14	3.78	3.54	2.34	4.12	4.80
	25	68.0	.47	.32	3.68	.60	1.03	3.93	3.70	3.14	3.98	4.98
	27	67.0	.35	.24	2.69	.63	1.14	3.98	3.79	3.20	4.27	5.09
	28	70.3	.42	.31	3.54	.58	1.28	3.92	3.80	3.20	4.15	5.04
	29	63.0	.42	.24	2.76	.60	1.28	3.99	3.82	3.23	4.65	5.05
	30	72.0	.34	.29	3.34	.67	1.19	4.05	3.94	3.36	4.42	5.19
	31	66.6	.40	.26	3.30	.69	1.25	4.04	3.94	3.38	4.68	5.21
Feb'y	1	70.3	.39	.29	3.35	.68	1.21	4.05	3.91	3.40	4.60	5.21
	3	67.5	.36	.24	2.84	.70	1.21	4.10	4.00	3.40	4.83	5.22
	4	69.0	.41	.29	3.39	.71	1.22	4.10	4.00	3.44	5.02	5.20
	5	70.0	.43	.32	3.61	.71	1.23	4.11	4.00	3.46	4.93	5.22
	6	72.7	.41	.29	4.79	.70	1.30	4.10	4.00	3.45	4.91	5.22
	7	67.0	.37	.24	2.76	.71	1.25	4.10	4.01	3.47	5.22	5.25
	8	73.0	.34	.27	3.12	.72	1.17	4.16	4.04	3.49	5.04	5.30
	10	69.0	.38	.28	3.23	.76	1.18	4.18	4.04	3.52	5.21	5.31
	11	72.0	.36	.28	3.27	.78	1.23	4.14	4.02	3.50	5.13	5.31

Measurements of Textile Bands, &c. — Continued.

1879.		Atmosphere.				Cotton Braided Banding.						
Date.		Temperature, Degree.	Relative Humidity.	Vapor Tension, In. of Mercury.	Water per c. foot, Grains.	Linen Core.	Worsted Core.	Cable, no treatment.	Braided, no treatment.	Treated with Naphtha.	Treated with Paraffine.	Made into Parchment.
Months.	Days.											
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
						Percentage of Increase in Length.						
Feb'y .	13	71.0	.41	.31	3.55	.70	1.32	4.10	4.12	3.55	5.40	5.40
	18	69.0	.45	.32	3.68	.73	1.39	4.18	4.15	3.63	5.64	5.38
	19	63.0	.38	.22	2.59	.76	1.35	4.23	4.20	3.69	5.89	5.42
	20	69.6	.37	.27	3.10	.81	1.34	4.21	4.21	3.69	5.77	5.44
	21	65.5	.33	.22	2.49	.87	1.30	4.27	4.25	3.73	5.82	5.48
	24	50.0	.45	.16	1.89	.70	1.40	4.24	4.23	3.72	6.10	5.46
	25	71.0	.33	.25	2.92	.90	1.27	4.32	4.30	3.79	5.70	5.49
	26	72.0	.38	.30	3.43	.90	1.37	4.27	4.27	3.78	5.70	5.50
	28	67.6	.38	.26	3.04	.97	1.31	4.33	4.33	3.85	5.87	5.54
March .	15	64.3	.37	.23	2.66	.90	1.38	4.29	4.29	3.87	8.65	5.58
	17	65.0	.45	.28	3.24	.85	1.51	4.26	4.31	3.83	8.68	5.55
	18	68.0	.39	.27	3.08	.89	1.44	4.33	4.32	3.87	8.63	5.57
	20	65.0	.44	.27	3.08	.91	1.45	4.31	4.40	3.90	8.83	5.59
	21	61.3	.51	.28	3.26	.79	1.55	4.22	4.29	3.80	8.80	5.52
	22	65.6	.49	.33	3.78	.82	1.52	4.24	4.31	3.81	8.71	5.54
	24	69.0	.50	.38	4.29	.78	1.55	4.21	4.27	3.79	8.49	5.53
	25	68.5	.48	.34	3.87	.79	1.54	4.20	4.29	3.80	8.66	5.53
	26	73.9	.79	.68	7.48	.12	1.53	4.09	4.29	3.85	8.41	5.61
	27	71.5	.51	.41	4.52	.59	1.45	4.66	4.82	4.59	8.45	6.25
	28	69.0	.46	.33	3.81	.76	1.40	4.79	4.90	4.60	8.67	6.34
	29	69.3	.49	.35	3.99	.76	1.44	4.80	4.92	4.61	8.74	6.37
	31	68.5	.45	.30	3.43	.80	1.42	4.83	4.92	4.62	8.75	6.39
April .	1	65.0	.42	.26	3.00	.84	1.39	4.90	4.90	4.65	8.84	6.44
	2	68.0	.40	.28	3.17	.92	1.37	4.93	4.97	4.71	8.73	6.48
	4	66.0	.35	.22	2.60	.99	1.35	5.01	5.02	4.76	8.98	6.52
	5	64.7	.43	.26	3.02	1.00	1.39	4.99	5.02	4.75	8.93	6.51
	7	66.0	.45	.29	3.34	.96	1.46	4.93	5.00	4.72	8.91	6.50
	8	67.0	.44	.29	3.38	.99	1.41	4.99	5.00	4.77	8.88	6.50
	9	66.0	.45	.29	3.32	1.00	1.44	4.95	5.00	4.77	8.95	6.50

ENGLISH YARN TRAFFIC.

Yarns are sold first to English consumers, as manufacturers, dyers, and doublers, and for shipping abroad, in three forms, — cops, warps, and bundles.

Cops are necessarily mule-spun, and are used both for twist and weft; being packed for home use in skips (or baskets), holding about two hundred and fifty pounds each, and for shipment in casks, holding about six hundred pounds each. Skips are always returnable, whilst casks are charged.

Thirty-two and thirty-three are the counts of cop-twist most largely bought by both home users and shippers; and thirty-six and forty, of good quality, are the numbers most largely used in pincops or —

Warps are usually and chiefly made of throstle-spun yarns, the largest weights being taken in counts below twenty-four.

Bundles are made up in both mule and throstle yarns. For "English consumption" the hanks are usually made "cross-reel and double hanks;" and the bundles weigh ten pounds net of yarn.

"For shipment" the hanks are reeled "seven leas or straight reel;" and, because of the paper employed in tying up the bundles, nine pounds fourteen ounces of yarn is the rule in a ten-pound bundle.

The "terms" of payment in the yarn-trade are: to home consumers, two and a half per cent discount for cash in fourteen days after delivery, or one and a half per cent for payments made monthly; to shippers, a discount of ninety-five days, interest at five per cent per annum in fourteen days after completion of order, when the whole is invoiced.

Exports of English Yarn for the Year 1878.

1878.	Germany.		France.		Russia.		Holland.		Italy.		Austrian Territories.	
	Pounds.		Pounds.		Pounds.		Pounds.		Pounds.		Pounds.	
January . . .	3,606,500	£205,998	601,900	£38,232	24,400	£2,491	2,379,500	£123,430	1,553,900	£73,582	121,900	£6,128
February . . .	3,777,400	199,977	636,500	41,407	39,400	5,949	2,255,400	118,850	1,545,500	70,655	154,200	7,015
March	3,323,700	192,270	660,300	42,185	194,100	12,567	2,832,400	145,800	1,609,500	71,661	325,600	15,938
April	3,471,700	188,724	632,200	45,359	460,100	33,749	2,908,500	146,690	1,369,500	64,441	308,800	13,354
May	3,274,900	169,542	773,900	51,397	517,100	39,833	2,866,600	142,914	2,260,700	101,717	304,100	13,866
June	3,943,300	210,596	630,200	43,383	276,000	20,525	3,288,200	166,374	981,700	43,707	255,700	11,620
July	2,943,300	172,416	555,600	42,361	778,100	54,575	3,163,600	176,369	870,400	39,339	372,900	16,308
August. . . .	3,007,600	183,201	616,100	42,951	1,195,600	76,603	3,087,500	177,596	1,147,500	53,798	279,100	12,420
September . . .	2,360,500	147,372	491,000	38,289	1,515,600	91,837	2,739,000	153,594	1,024,600	47,837	223,900	9,396
October . . .	3,219,806	186,051	547,200	42,107	2,025,900	99,851	2,894,500	157,300	1,342,000	62,250	177,700	8,004
November . . .	3,122,100	179,026	521,800	40,634	1,289,200	62,590	3,092,200	158,773	1,581,000	74,157	264,300	11,441
December . . .	3,356,300	189,700	398,100	30,355	1,213,100	57,084	2,686,700	139,574	1,699,800	77,708	230,500	10,161
Total . . .	39,414,100	£2,224,873	7,064,800	£498,660	9,528,600	£557,654	34,194,100	£1,807,264	16,986,100	£780,852	3,018,700	£135,651

Exports of English Yarn for the Year 1878. — Continued.

1878.	Turkey.		Egypt.		China and Hong Kong.		India — Bombay, Madras, Straits Settlements, and Ceylon.		Japan.		Other Countries.	
	Pounds.		Pounds.		Pounds.		Pounds.		Pounds.		Pounds.	
January . . .	795,000	£37,194	303,400	£14,825	968,600	£44,195	2,897,400	£181,000	2,068,600	£83,189	2,168,000	£113,855
February . . .	697,800	35,505	381,100	18,420	933,900	42,808	2,611,000	159,113	3,658,100	147,908	2,218,900	117,174
March	1,009,100	48,460	317,900	15,260	570,000	24,898	3,732,500	214,330	3,012,800	119,409	3,174,600	159,249
April	1,567,800	75,056	276,900	13,660	1,256,000	50,598	3,131,600	201,529	2,985,400	116,761	3,975,800	196,463
May	1,854,500	89,173	199,600	8,840	872,400	35,098	3,111,100	194,615	2,454,200	94,935	3,718,800	179,467
June	2,998,600	146,743	206,100	9,500	1,240,100	48,965	3,392,300	204,109	2,407,400	89,988	4,055,500	194,171
July	3,660,300	172,883	336,100	16,205	979,400	39,493	3,074,700	192,609	2,725,800	104,348	3,193,200	165,649
August. . . .	2,970,400	135,566	324,500	14,916	929,800	34,769	2,499,600	161,878	1,416,900	57,164	3,228,800	158,798
September . . .	3,641.400	172,605	332,200	16,230	498,400	21,897	2,469,500	161,113	1,188,800	45,290	3,133,900	155,164
October . . .	2,479,200	117,883	330,500	14,666	873,800	36,005	3,385,700	214,609	2,110,100	81,300	3,226,200	154,013
November . . .	1,619,100	77,051	485,600	23,774	1,372,800	51,098	3,036,900	195,055	654,000	22,696	3,355,100	170,125
December . . .	1,810,900	89,385	296,300	14,677	513,000	20,596	2,420,600	157,476	618,500	21,160	4,017,400	188,336
Total . . .	25,104,100	£1,197,504	3,790,200	£180,973	11,008,200	£450,780	35,762,900	£2,367,436	25,300,600	£984,148	39,666,200	£1,952,464

	Pounds.		
Total for 1878	250,838,600	£13,038,345	$63,366,356 70
Total for 1877	227,651,402	12,192,954	59,257,756 44
Total for 1876	232,554,627	12,781,733	62,119,222 38
Grand total	711,044,629	£38,013,032	$184,743,335 52

The Secretary regrets to state that the disastrous fire of Dec. 28 last, which destroyed the Heliotype Printing Company's works, caused the loss of the diagrams illustrating Mr. Waite's machine, and also certain drawings and diagrams supplied by Mr. Atkinson, and somewhat delayed the printers, Messrs. Rand, Avery, & Co. In consequence, Mr. Waite's article cannot appear until the next Report; nor any of the other drawings, except Mr. Atkinson's valuable Statistical Chart.

Boston, January, 1880.

No. 27.

N.E. COTTON MANUFACTURERS' ASSOCIATION.

PROCEEDINGS

OF THE

SEMI-ANNUAL MEETING,

HELD AT BOSTON, OCTOBER 29, 1879.

BOSTON:
FRANKLIN PRESS: RAND, AVERY, & COMPANY.
1879.

FRANKLIN PRESS:
RAND, AVERY, AND COMPANY,
117 FRANKLIN STREET,
BOSTON.

CALL FOR MEETING.

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION,
BOSTON, Oct. 1, 1879.

DEAR SIR, — The stated Semi-Annual Meeting of the Association will be held at the Massachusetts Institute of Technology, Boylston Street, Boston, on Wednesday, Oct. 29, 1879, at ten o'clock A.M., with an afternoon session beginning at two o'clock.

Topics heretofore discussed will still be in order if called up by any member; and, in addition, the Board have the pleasure to announce the following: —

CHARLES L. LOVERING, Esq., of Taunton, Mass., will give some account of his observations of cotton manufacture in England.

J. G. GARLAND, Esq., of Biddeford, Me., will exhibit and explain his new apparatus for moistening the air in cotton mills.

EDWARD ATKINSON, Esq., of Boston, Mass., will report the result of recent trials of hose, with a view to determining the best kinds for mill use; and will also present a statement of the information desired for the United States census of 1880, relating to cotton manufacture.

CHARLES N. WAITE, Esq., of Manchester, N.H., will explain his new machine for testing friction.

The subject of the Cause of Vibration in Factories or Machines, and its Remedy, is also suggested for discussion.

An early and full attendance is invited.

By order of the Board of Government.

AMBROSE EASTMAN, *Secretary.*

PROCEEDINGS.

PURSUANT to the foregoing notice, the stated Semi-Annual Meeting of the New England Cotton Manufacturers' Association was held at the Institute of Technology, at ten o'clock A.M.

About one hundred and fifty members were present.

The President, Mr. A. D. LOCKWOOD, occupied the chair.

The following gentlemen, upon nomination, were elected members of the Association: —

J. DWIGHT FRANCIS, Pittsfield, Mass.
HERBERT FISHER, Dedham, Mass.
ROYAL O. STORRS, Dedham, Mass.
C. J. H. WOODBURY, Boston, Mass.
TIMOTHY MERRICK, Holyoke, Mass.
WILLIAM P. DERBY, Springfield, Mass.
RUSSELL HANDY, Manville, R.I.
GEO. W. HOLT, JUN., Putnam, Conn.
HUBBARD WILLSON, Cordaville, Mass.
Z. D. HALL, Lowell, Mass.
JAMES G. GARLAND, Biddeford, Me.
EUGENE H. SAMPSON, Boston, Mass.
E. S. BOSS, Willimantic, Conn.
JOHN SCOTT, Willimantic, Conn.
JAMES GRANT, New York City.
JAMES M. HARVEY, Hallowell, Me.
GEORGE H. SIMMONS, Ansonia, Conn.

The following gentlemen, having retired from the business of cotton manufacturing, upon request were granted leave to withdraw from membership: Messrs. GEORGE W. HOLT, J. A. PEIRCE.

The PRESIDENT. At the former meeting Mr. Goulding and others were appointed a committee on the subject of tare on cotton. I would inquire if Mr. Goulding is ready to report.

Mr. GOULDING. We are.

Mr. GOULDING then read the following report: —

REPORT OF COMMITTEE.

MR. PRESIDENT AND GENTLEMEN, — Your committee beg leave to report, that in the investigation they have been able to give the matter of cotton tare, they have felt with renewed force the reasons that have been so often urged, and are so well understood by all of you and us, why the buying of cotton *gross* is a manifest injustice to both the buyer and seller.

Cotton is the only article we consent to buy in this way. When we buy oil, we buy the *net* gallons contained in a barrel, cask, or car, and the oil is furnished with a proper package to protect it. It is easy to say that the net price of the oil covers the cost of the barrel. We admit it; it must be so. So must the net price of cotton carry the cost of protecting it until delivered to the customer; and, if cotton is sold *net*, a healthy competition will arise among the planters to secure and use such protection as will protect the best, and cost and weigh the least, and the present temptation to load the cotton with just as much coarse bagging and hoops as possible will be forever removed.

We are disposed to put the buying of cotton net upon the abstract principle of right and justice; that it is not right to sell bags and hoops at cotton prices, no matter whether the English or French buy it so or not; no matter whether the buying of cotton net gives us an advantage over the foreign buyer, or places us on an equality with him. There can be no good reason assigned why we should pay cotton prices for the coarse, cheap package that covers cotton.

In making up the cost of producing cotton, the bags and hoops should be charged as cost, the same as the ginning or any other expense attending the putting of the cotton upon the market. What would our merchants say if we charged the burlaps and cases we use in sending goods to them, at the same cost per pound as the goods in the cases? Are not these cases a parallel instance?

If there is any thing about which the average business man is sharp and careful, it is in weights and measures. It is a universal trait, and lies at the foundation of all laws of equal and exact justice in trade; it appoints sealers of weights and measures in every town and city; it appoints sworn measures

for wood, bark, coal, staves, lumber, &c.; every precaution is taken to insure full and exact measure and weight to the party that buys.

Every one recognizes the justice of this. Not a man in this city who is in the habit of buying cotton for our mills, but would protest in a moment against even his grocer weighing his tea and sugar in the scales with the paper and twine that is to do them up. The flour that he buys must weigh one hundred and ninety-six pounds *besides* the barrel; the raisins must be net weight, and the fig-box must be deducted. It is right and proper that they should be thus careful; but these items are trifles compared with the amount they pay for cotton bags and hoops, and are only mentioned to show how careful they are about paying for tare in every thing except cotton.

Let us look at a few figures in this connection. The estimated amount of cotton to be used by the United States this year is 1,586,960 bales, which at 475 pounds to the bale will equal 753,806,000 pounds. Six per cent tare on this will amount to 45,228,360 pounds, and at ten cents per pound it will equal $4,522,836 — that the Southern planters will be paid this year for bags and hoops at the price of cotton. Thus the cotton mills have over four and a half million dollars to earn and pay for what they never had (as the little we get for bags and hoops hardly pays for the labor expended on them at the mills).

Here is the interest at six per cent upon $75,380,600, paid for bags and hoops at ten cents per pound; and as all the cotton bought in this country, both for European and American consumers, is bought gross, this figuring when applied to all the crop of 5,000,000 bales makes a sum of money that cotton manufacturers ought to look at.

For a moment consider that it is true that all the cotton is bought gross. Of course it is sold to the English at the market price of cotton at the South. They may have made the price themselves that governs them and us, the same price that we can buy it for in the same market, at the same time. I believe the brokers will admit that in the open markets of the South we can buy the same grade of cotton at the same price that the English can, and that in fact we do pay the same prices. Now, the foreign spinner buys of somebody, — who? Cotton with six per cent tare allowed, so that he gets practical-

ly net weight, and has this six per cent advantage over us. If it is claimed that the foreign buyer fixes the price of the whole cotton crop at a point where he can make six per cent reduction to his customers, we have to pay that price for what we buy, — hence the disadvantage; or, if he pays the market price for cotton the same as we do, and then deducts the six per cent from his profits, the practical effect is the same: that the spinner with whom we compete pays for six per cent less of cotton than we do.

It is assumed by some that we cannot buy cotton net weight; but your committee have not reached that conclusion, and believe that steps ought to be taken at once by those who consume and buy the cotton, to change not only the system of buying, but the method of cleaning and bailing cotton, so that we shall get cotton free from sand and other foreign matter — which, besides the tare for bags and hoops, adds at least two per cent of the 1,586,960 bales of cotton consumed in the United States. This would amount to 14,171,552 pounds, the cost of which added to the six per cent tare for bags and hoops makes the sum of $5,939,991 which the cotton mills must pay for as cotton, but which no mortal man or method can make into cloth, though they have expended upon it an incalculable amount of labor in the mills and $141,715 for freight on the sand alone. And all this that we may make a compost heap with it, and as much more at least of cotton seed that ought to have been left at the gin.

By this showing we have a total of $6,081,706 worth of refuse that we pay for as cotton, which is 8.07 per cent of the entire gross amount of dollars paid for the cotton crop at ten cents per pound.

American manufacturers have astonished the world by their success in textile industries (as well as other pursuits); they have introduced new methods of business, that are being adopted throughout the world; and when we take a survey of what obstacles they have already surmounted, it is not a compliment to their intelligence and ability to say that they cannot devise a method by which they can buy cotton net, as well as the foreigners who have learned by an experience of two hundred years that to buy cotton net is the right way. The fact that two-thirds of the crop is now sold to the consumers at net weight, divests the proposed change of the appearance of an

experiment, and only increases the wonder that we have so long consented to pay for gross weights in buying cotton.

Your committee may reasonably be expected to recommend some plan or method of effecting this change; and they would say that they do not recommend action in the Legislature of this or any other State, knowing the danger attending legislation for any section or class of men or industries. They do, however, believe that combined action on the part of those who buy cotton for use would effect the change from buying gross to buying net, without any disturbance or difficulty that ought for a moment to deter them from the attempt. And the same combined effort in the direction of improved ginning and cleaning of cotton would result in giving us cotton free from sand and seed, so that the waste account of our mills would show an improvement that would justify even an expensive and persistent effort to change the present method of preparing and buying cotton.

In behalf of the committee.

WILLIAM F. GOULDING, *Chairman.*

Mr. NOURSE moved that the report be accepted.

Mr. ATKINSON. I would suggest one slight amendment. The term "two hundred years," where the report refers to "experience in cotton manufacturing," should be changed to "one hundred years." It is only about one hundred years since Arkwright's inventions.

Mr. GOULDING. I accept the suggestion. But, if we come to the point of exact accuracy in the matter, I think the history of cotton manufacturing dates back in England two hundred years. The history of machines for manufacturing cotton goes back about one hundred years; but they manufactured cotton by hand in England two hundred years ago.

Mr. ATKINSON. Before the report is accepted I take some slight exception to a position taken in it. It would be well, I think, that that report should be accompanied by a table running back some fifteen or twenty years, — such as I once made. I computed the price of cotton, twice a month, in Great Britain and in America, for a sufficiently long period, — I don't remember exactly how long, — reduced the Liverpool price to the American price, in currency, and made the exact comparison. I found that the English spinner, in the long run, paid a differ-

ence of freight, insurance, and other charges, equal to between $\frac{6}{10}$ and $\frac{7}{10}$ of a cent per pound on the weight of the cotton; that he also paid a sum, in addition to the New York price, equal to the six per cent tare and the other deductions that are made in Great Britain on the sale of cotton. This table proved that the English spinner, taking his cotton on the same dates, twice a month, paid the difference of about $\frac{7}{10}$ of a cent per pound to compensate for the distance between England and America. That is a question of fact. It does not touch the argument of the paper presented. I heartily sustain the report, because it is in the direction of non-legislative action; legislative action, I think, would be mischievous. The great point that would be brought about, if the buying by net weight can be assured, will be the better methods of ginning and packing which are suggested in the report. Whenever the growers of cotton can get a price that will warrant the additional care in the ginning and packing, and the putting on of proper burlaps instead of heavy bags, we may be very sure that the laws of trade will bring about the object advocated in the report. They are becoming alive to the necessity of that sort of economy. It will be remembered that some two or three years ago the diagram of a "trash-cleaner" was brought before us by a gentleman from Providence, — an invention that had been made in Texas. That machine has been at work since that time in Texas, and cotton in sufficiently large quantities and of a sufficiently improved quality, prepared by it, has been offered for sale, and has been sold at a price sufficiently higher to warrant the continuance of the use of that machine. It appeared when exhibited here a very crude machine. It has been perfected. There is also a vast room for introduction of better ginning; and when discrimination is used in buying according to the quality and careful packing of the cotton, we may gradually bring about carefulness in handling, the same as that which would be used with respect to a bale of cotton cloth. That is the way it ought to be with a bale of cotton, — not stored in cellars in order that it may become damp before it is sold. When I was in the South a little while ago, I learned that the favorite place of storage of cotton, in one of the cities, was in very damp cellars, because dampness added weight to the cotton. For the same reason they were in the habit of leaving it out on the sidewalk, in the rain, before shipping it.

[The motion for the acceptance of the report was adopted.]

The PRESIDENT. What disposition will you now make of the report? If no motion is made in regard to its adoption, it will be placed on file.

I had hoped the report would lead to some discussion. This report presents one view of the question. There are two sides to this, as to almost every question; and we have had an intimation already to that effect, — and while this report is quite full and clear, and presents the matter properly before the Association, it is not clear to my mind, and I presume it is not to others, that the ground taken here is correct, so far as it is assumed that the American spinner pays just so much more for his cotton in consequence of there being a difference of tare to the American spinner from what there is to the European spinner. It is not true of the English as much as of the American spinner, that he buys his cotton direct from the planter, or from the markets in this country. In Europe there comes in to a greater extent than here, if I understand the matter, a class between the spinner and the seller, or broker, at the South. In this country, as is well known, to a very large extent of late years, cotton is bought directly by the spinner from the South. Instead of going to New York, Boston, or Providence, and buying of cotton dealers, he goes directly to the South. The English merchant buys the cotton on the same terms and conditions that the American spinner does. It is shipped to England; it is sold to the English spinners by those who purchase of the Americans; and, in the adjustment of prices, of course the question of tare must come in as a part of the cost, or the expense on the cotton. The Englishman buys the cotton, so far as tare is concerned (if I am right) at the South, on precisely the same conditions that the New Englander buys. There is no difference. That matter of tare is adjusted subsequently. I may be in error; I think not, however. I make these few remarks to bring the matter up, hoping thereby to bring out some further thoughts and discussion, — as it is a matter of very great importance, and I think we ought not to lay it on the table, and leave it, and go home feeling that there is nothing to be said. This report tells a part of the truth, and truth that ought to be told; and I fully agree that there ought to be a different system in regard to tare; that this transporting trash, sand, cotton-seeds, here or to Europe, and paying freight on them, and on an

unnecessary amount of ropes and bags, or iron bands, ought to be avoided; because there is in that an expense that the consumer has to pay. My remarks are directed to the point that we are not placed to so much disadvantage above the Englishmen as might at first seem from the language of this report.

Mr. GARSED. I will call the attention of the meeting to what men have stated, that the English spinners, buying two-thirds of the cotton crop, fixed a price so that they could allow of six per cent of tare in Liverpool. Now I would like to ask you: Admitting that the American dealer will buy the same amount of cotton as the Englishman's dealer in Savannah or any other city, whether it is true, as assumed by Mr. Nourse, that the English buyer fixes the price? Does not the American buyer pay that six per cent upon that fixed price? If cotton would bring but 9½ cents in Savannah, all bought alike, irrespective of tare, — suppose there was no tare in England more than in the United States, then would not cotton at 10 cents per pound come down to 9½? I simply call your attention to Mr. Nourse's argument, to bring out discussion.

The PRESIDENT. Mr. Nourse is not present. I wish he was, because we consider Mr. Nourse pretty good authority.

Mr. GOULDING. If it will facilitate this discussion, I will say that I have a long communication from Mr. Nourse, addressed to the gentleman last up, treating upon that subject, and that he takes precisely the same position that Mr. Garsed has assumed.

Mr. ATKINSON. I shall take the ground that neither the Englishman nor the American fixes the price of cotton. It is fixed by the relative supply and demand in the world. In fact, the whole American crop of cotton is first sold on its gross weight, to be distributed by the persons who buy it, either in England or America, according to the customs of the respective final markets. The English exporter, the English buyer, everybody except the planter who consigns his own cotton to Liverpool (who may be counted out as an insignificant factor, if he exists at all), every buyer, whether in England or America, pays the price on the gross weight of the cotton; and the cotton does not go to England to be sold unless it brings a price there that will pay all discounts, no matter what discounts, or what tares, or what other costs and charges come in — the cotton does not go to England, in preference to Boston,

or New York, or Lowell, unless it brings a price that will compensate for all those differences. It would not be in the power of Englishmen or Americans to fix the price. The demand of either of them is too large to admit of the other's doing that. They both affect each other. It is the demand of the whole. The point to which the report is directed is a better method of handling and packing, that will save waste to everybody. The Englishman will get just as much benefit from it as we do precisely — no more and no less. Our advantage over the Englishman will be the permanent advantage of proximity to the cotton field, and that on the whole is equal to about $\frac{6}{10}$ of a cent a pound. An illustration of this matter, of the most complete sort, which has just come to my knowledge, has been a contract lately made for carrying cotton from Northern Texas through Boston to Liverpool, for ten thousand bales. The rate of freight charged from Northern Texas (I don't know the exact point, but no matter), through Boston to Liverpool, was $1.10 per hundred pounds, — of which the rail to Boston received 70 cents, and the cost of transfer and steamship charges was 40 cents; to that add $\frac{1}{8}$ per cent insurance and $\frac{1}{4}$ of a cent per pound for freight from Liverpool to Manchester, and that cotton cost, for all charges through from Northern Texas to Manchester, England, $1\frac{39}{100}$ cents per pound. The same cotton, under the same conditions and the same contract, can be laid down in Massachusetts, Rhode Island, or Connecticut, and perhaps in Maine, for 70 cents per hundred pounds. That makes a difference of $\frac{69}{100}$ of a cent per pound in our favor, which cannot be overcome. That means three thousand miles of ocean.

Mr. GARSED. Mr. Atkinson does not start at the right point, any more than my friend Mr. Nourse. I make the point, sir, that the foreign buyer, buying the larger amount of cotton, and thereby controlling the market (because I will not accept Mr. Atkinson's position that he does not control it; he does control it), when the despatch comes saying, "Cease buying at this price," the cotton comes down.

Mr. GOULDING. I want to fasten the matter at the position: At what price is cotton sold in the South? I admit that cotton costs more in Liverpool than in New York, because there are three thousand miles more of ocean to go over. But I cannot help admitting, that if it is a fact that we buy, in the same market, as stated by the gentleman, at a price fixed by this

larger power, — as an illustration, the English buyers, the Continental buyers, and the French buyers, control the Southern markets, and, when they fix the price, they fix the price so that they can make the allowance for tare, in Manchester or Havre or Bremen, or wherever the cotton is sold, — I cannot get it through my head that there is any justice in American manufacturers buying cotton gross, and English manufacturers buying it net. If there is nothing wrong in the matter, why the prompt manner of the National Exchange, the other day, in their meeting in New York, disposing of the whole tare question at a word? The very moment the question of tare on cotton came up, it was of no consequence, it was disposed of. Now, if there is nothing wrong about it, why do we not have tare on the cotton, the same as anybody? And, if there is a wrong about it, why give tare to anybody? If three-quarters of the cotton is sold with the tare off, why not sell the other quarter with the tare off also? Is there any other staple of the magnitude of cotton, — take tobacco, or sugar, or rice, — is there a single one where there is not a tare allowed? Who ever heard of coffee being sold, the price of the bag with the coffee, — or any such article, spices, drugs, &c.? I think it is a universal rule, that we pay for the article and not for the wrapper. Now, the world has fixed a tariff upon cotton tare, — not the absolute tare; they fix it at six per cent. But if the cotton is rolled in mud, or is sent wet, then they strip the bales, and weigh them, and get the actual tare. Now, you know how impossible that is for us, where there is no tribunal to refer it to. I ask any gentleman who buys cotton, how it is in his case. He never sees the cotton until it gets to his factory, and there he finds it covered with trash and mud. The weigh-master will tell him, "All I had to do was to weigh the bales. The mud and wet is so much for you to look out for." Then you are referred back to the man you bought it of, and then to the man from whom he received it, and so back from hand to hand. There is no tribunal. There are no rules to be governed by. You take the best means you can for a settlement, and vow you will not buy of that man any more. Now, the American spinner is not on an equal footing. I am taking it now upon the six per cent tare, not what we have to buy of trash, mud, wet, and so forth.

The PRESIDENT. I would like to ask one question, — to

bring out the fact for the benefit of all: Whether, when the cotton is bought of the planter, the planter sells his cotton to parties purchasing for the English market, on any different terms, so far as regards the tare, than he does to parties purchasing for the American market?

Mr. GOULDING. If Mr. Nourse was here I should ask him to answer that question, and you could consider his answer as sufficient.

The PRESIDENT. I would not consider it absolutely sufficient. I would give it some weight.

Mr. GOULDING. In this letter, Mr. Nourse says, "The merchant who imports his ten thousand bales at Liverpool or Bremen allows his merchant to buy gross bales there, as he must; but he protects himself, and a little more, by stipulation in the order to his agent, that the cost should include an allowance of six per cent from the gross weight. Thus guarded, he loses nothing by delivering net weights to the spinner. The chances of the market, and the risk of fall of the prices, have nothing to do with those; and upon those chances John Bull bought his cotton gross, and uses it, omitting intermediate traffic, net, but saves himself six per cent in the price."

Mr. Nourse assumes in the letter previously, and in another letter to me personally, that the cotton sold in the South is sold "gross" to the buyers.

Mr. THOMPSON. If I understand the matter, — I have bought a little cotton for a few years, — if I sent an order to New Orleans yesterday for one hundred bales, and the party buying for me goes into the same commission house, holding a thousand bales of cotton, he buys nine hundred, and I buy one hundred; we pay precisely the same price; I don't understand that I pay six per cent more upon the same samples than the Englishman does. If I did, I should be mad right off. Now, I understand that is the way we trade. I buy one hundred bales, and the Englishman buys nine hundred. He pays precisely the same price. I don't know or care whether you call it "tare" or not. I think Mr. Atkinson's ground is right. I cannot see Mr. Garsed's ground. He makes the point that the Englishman fixes the price of cotton. Supposing he does, what are you going to do about it? Supply and demand fixes it, in my judgment. Supposing there are thirty thousand tons of hay in Maine: one man goes down there, and pays twenty

[illegible] and the man who buys the [illegible] at the same. It is nobody's [illegible]

Mr. [illegible] The gentleman's argument suits me exactly. [illegible] Now, if he has one man weigh twenty thousand [illegible] the price. [illegible] and he can only [illegible] six per cent [illegible] Now, if he has a man to weigh [illegible] allow the six per cent.

[illegible] while I am on [illegible] The [illegible] Ohio at the South by the [illegible] Now, if he has a broker in the [illegible] when will he have to sample around the town, the first time you go to an elevator the [illegible] Now, that is the reason why I proposed that for a chance to [illegible] around the edge of the pan. They don't [illegible] Now, if he has a couple of loads of 50 [illegible] Ohio does that. But [illegible] Now, if he has a couple of loads of 50 [illegible]

The President. There was a question addressed to the [illegible] I heard [illegible] I understood [illegible] I understood [illegible] while the American [illegible]

Mr. [illegible] [illegible] the quarter sel[illegible]

The President. Does he make any difference between the Englishman and the American?

Mr. [illegible] None whatever. The gentleman does not state it correctly.

Mr. Atkinson. It is [illegible] the American buyer to get more [illegible] Englishman does. The price of [illegible] New Orleans being ten cents per pound, you can [illegible] ten cents per pound, the [illegible] six cents per pound. When he buys [illegible] New Orleans is ten cents per pound for [illegible] you will not

get it. The Englishman will not get it on an order of that sort. You will pay a little over $10\frac{6}{10}$ cents before you get your cotton. That is exactly what happens to the English or Bremen buyer. They must pay the market price, on gross weight, or they don't get it.

Mr. GOULDING. Is not that precisely the point the report takes, — that the very fact that he has got to sell that cotton to the European spinner at six per cent tare is taken into consideration when he gets the cotton? But the tare is not taken off in our case. The $10\frac{6}{10}$ cents fixes the price of the cotton, and the $\frac{6}{10}$ is taken off to the Englishman and not to the American.

Mr. ATKINSON. You get for 10 cents gross what the Englishman pays $10\frac{6}{10}$ cents net for, practically. I say, if the quotation is 10 cents, he is expecting to lay the cotton down in Europe at $10\frac{6}{10}$ cents net. He covers tare, in his order, and so do you. All the quotations of this country are for gross weights. As we buy one-third, and the Englishman two-thirds, we buy one bale to the Englishman's two, and there is not difference enough to make a difference in price on that. It is a perfect absurdity and a great nuisance that the cotton crop should be sold at a gross weight. It is in the power of thirty or forty men in Boston, Providence, and Philadelphia, to establish net weights, if they can make a combination; but I never knew a combination of more than two to succeed. If you could get a combination of forty, and agree to buy cotton only at net weight, you would establish tare on cotton in that way.

Mr. THOMPSON. Allow me to say a word, in justice to Mr. Goulding. I agree with his report entirely — except that the Englishman pays less for cotton than I do, buying at the same moment in New Orleans. Otherwise I agree with him, — that the tare ought to be taken off.

Mr. GOULDING. I think that the committee do not assume that thing; but they say that the brokers say it. We took mainly the testimony of Mr. Nourse in this matter, — that the cotton buyers in America, on the same day and with the same grade of cotton, can buy at the same price that the English do; and on the strength of that we take that position. I would like to say also that the committee do not assume that there is this difference; but we ask: How is it, and who makes the reduction? If we start from the same premises, and the con-

sumer abroad buys with a six per cent off for tare, who makes the reduction, and where is it made? The Liverpool merchant gives an order for ten thousand bales of cotton, limited at 10 cents. The buyer must protect himself; if he is going to make the same profits that our cotton-broker does, he must fix a price so that he can make the reduction of six per cent for tare. Having fixed that, we do not get that deduction. We cannot see why there is not that disadvantage, and hence we say so in the report. We do not get that reduction.

The PRESIDENT. I would like to call your attention to a single paragraph in the report: —

"Your committee might reasonably be expected to recommend some plan or method of effecting this change." They go on to say that they would not recommend legislative actions, &c. I would suggest that this matter be referred to the same committee for further consideration, and that at the next meeting they report some method of action by which the desired end may be reached, — some method well considered and digested, after such consultation as may be necessary, so that we may have something a little more clearly presented as to what can be done. One member asks here, "What are you going to do about it?" Well, we would like to have this committee, who have this thing in their minds, just tell us at the next meeting what we are going to do about it.

Mr. THOMPSON. In what connection did you understand me to ask that question?

The PRESIDENT. I don't remember the exact point.

Mr. THOMPSON. It was: How are you going to fix the *prices?* If the Englishman buys two-thirds and you only one-third, he fixes the prices, and what are you going to do about it?

The PRESIDENT. It is for the Association to move in the matter.

Mr. NICHOLS. It seems to me that Mr. Atkinson has the right view of this question. I cannot see that there is any injustice in the way the business is done. If I am a planter, or a factor, and have a thousand bales of cotton to sell, — when I have made up my mind to sell at the market price of the day, I do not stop to inquire whether the man who is to buy my cotton is a native of Manchester or Lowell, whether it is destined for *Old England* or *New England.* I do not care, so long as I get my money. I sell to one as cheaply as to the other.

They both pay the *same* price at the starting point. But the cost to the consumer or manufacturer depends upon its destination. The manufacturer in Manchester does not get his cotton at the same price as the manufacturer in Lowell. If you take the price of cotton in Liverpool, and compare it with the price in New York or at the South, if no unusual local influences are affecting the market, I think you will generally find that if you take the price at the latter point, and add the freight, insurance, &c., and the commissions for handling, and add to this the six per cent tare taken out, and whatever other arbitrary local charges there may be, — you get the price of cotton in Liverpool. This *must* be so when the business is in its normal condition, for cotton, like all other merchandise, seeks the highest market. The six per cent allowance is *not* saved to the manufacturer. He pays it in the price he gives for the cotton in Liverpool. You will find this to be the case to-day, that the price of cotton in this country, with the additional cost of transportation, and with this tare, which is taken out, is the quotation of cotton at Liverpool; so that really there is no injustice in the way the business is done. It only remains for us to see that the amount of tare — the bagging and strapping, &c. — is the minimum amount that is necessary to cover the cotton.

Mr. CUMNOCK. We will say that cotton to-day is 10 cents in Savannah or Charleston, and an English buyer comes in and buys eight hundred bales, and a buyer from Boston buys two hundred bales: is it the universal rule that the Englishman is charged six per cent on his purchase?

Mr. NICHOLS. They both pay the same price. The man who has cotton to sell does not inquire whether he is selling to an Englishman or an American. But when the cotton gets to its destination, all the local charges and allowances must be added, and the consumer must pay them. The English manufacturer pays these, in addition to the amount that you and I pay for cotton at our mills.

Mr. CUMNOCK. Is that the fact? Is it universally done?

Mr. NICHOLS. I understand that this tare is allowed in the English market; and if there are any *other* local allowances, they must be added to the cost of cotton; the manufacturer pays these, in addition to what we pay here.

Mr. THOMPSON. It strikes me that the Englishman is too

smart to pay three-quarters of a cent more than we do. Now, suppose that I buy it, and ship it to him at just the fair cost: he will not have to pay so much as he pays his neighbor.

Mr. ATKINSON. There are plenty of buyers in the South that buy both for American spinners and English spinners. In point of fact, the last quotation for middling cotton in New York was 11½ cents, as I recollect. By the paper the last quotation of cotton in Liverpool was seven pence, at two cents to one penny, — that is 14 cents. Now deduct freight and insurance, and you have 13¼ cents. Deduct the six per cent tare, extra bags and ropes, and one and a half per cent trade discount, and you have eight per cent deduction in round figures. That is a cent; and that brings the price down to 12¼: therefore at the quotations of to-day the Englishman is paying 12¼ cents for the net weight of cotton, and charges, and we are paying 11½ cents for the gross weight of cotton in New York. That is about the proper difference in the market in the long run. The two quotations will come even in the long run. Take twenty years, two days in the month, and you will find that you must deduct from the English price the freight, insurance, and six per cent tare, and extra bags and ropes.

Mr. GARSED. The gentleman don't seem to get at the matter as I wish to put it. I don't mean to say that the Englishman and the American pay any different prices in Savannah or Charleston. But, taking my friend Thompson's illustration about the hay, suppose the man who wanted two thousand tons of hay went out of the market, and left the one that wanted one thousand tons in the market; the man that wanted the one thousand tons bid for it twenty dollars, and the other one wanted twenty-two dollars; and he withdrew. Now, what would be the effect on that market? The two-thousand-ton man went out, and said, "I will not give but twenty dollars." The other man wants twenty-two dollars. He has got his hay on hand; what has he got to do with it? He must either commence to sell with the man that wants the smaller quantity, and accept a lower price, or start with the man that wants two thousand tons at twenty dollars, — thus getting rid of him, and fixing the price. The Englishman does fix the price in Charleston and Savannah. If there is ten thousand bales in any one port, — I am speaking from actual experience, — and it is well known that the English buyer is ready to buy at 9½ cents, and

he is not willing to buy at 9§ cents, he withdraws. It is as common as it is to go and eat your dinner, that he does that thing exactly. Then what? The men must sell their cotton; and, if the Englishman will not advance, they have got to come to that price. Now, he buys with a view to six per cent when the price is fixed. The American cannot fix the price of cotton any more than he can upon any other article. No man can possibly fix the price at retail of the man that buys at wholesale. We are arguing that the large buyer fixes the price; and when there is a universal rule of tare, then we stand on a universally equal footing; and until you do have such a universal rule, you never will do it.

Mr. THOMPSON. If you can by Act of Parliament make John Bull withdraw from the market, you can get it cheaper. I don't think this Association can compel John Bull to withdraw so that they can get cotton cheaper. If Mr. Garsed wanted two-thirds of the cotton raised in the United States, John Bull would have to pay just what we said. If he did not want to give but ten cents, he would not get any if we gave twelve. When we got stocked up, he would get what was left.

Mr. GARSED. That is the argument, sir. That is sound.

Mr. ATKINSON. I move that the report be sent to the same committee, to propose a plan.

The PRESIDENT. You hear the motion of Mr. Atkinson, which is seconded. Are you ready for the question, — to refer this report back to the same committee, to investigate the matter, and to devise and report at the next meeting some definite plan?

Mr. ATKINSON. I would amend the motion by providing for the addition of one name to fill the vacancy that exists in that committee.

The PRESIDENT. I would suggest that that vacancy be filled with the name of B. F. Nourse. The committee then would be as follows: William F. Goulding of Lewiston, Me., B. F. Nourse of Boston, Hervey Kent of Exeter, N.H., Mr. Garsed of Philadelphia, and Mr. Cumnock of Lowell, Mass.

[The motion as amended was adopted.]

The PRESIDENT. The next business is to hear from Mr. J. G. Garland of Biddeford, Me., an explanation of his new apparatus for moistening the air in cotton mills.

REMARKS OF MR. J. G. GARLAND.

MR. PRESIDENT AND GENTLEMEN, — Before I explain my apparatus, I should like to bring to your notice a few facts with respect to our climate; for it is a very changeable climate, as you know. We have great changes in humidity, as well as in temperature. I suppose you have noticed the great change in temperature within a few days; and the change has been as great, also, in the humidity of the atmosphere. The Signal Service report that on the fifteenth day of this month we had only eight per cent relative humidity in the middle of the day, and on the twenty-sixth day only thirteen per cent.

Scientific physiologists say that we require an atmosphere containing sixty to sixty-five per cent relative humidity in order to be healthy, and our practice and experience seem to substantiate that idea; for dry air sucks out, as it were, the moisture of the system, tending to excessive insensible perspiration. Dry air does not check radiation, and moist air does. The old-fashioned plan of keeping heated rooms moist was to keep a dish of water on the top of the stove. You or I would not buy a furnace to heat our house with unless it had a water-pan connected with it so that the heated air might have means of absorbing water to moisten the air. Dry air is injurious, but moist air is not only healthy, but we can heat our rooms cheaper and easier with moist than with dry air. We need more knowledge and care on this subject for the good health of ourselves and families, as well as for all who work in the heated rooms of our mills.

Now, there is another thing, so far as your mills are concerned. It is very often that your work runs bad; the quality of your cloth is not what you desire it to be: so you go into the weave-room, and say to the weaver, "What is the trouble about the cloth?" He will say, "My harnesses and reeds are old and poor, and the work runs bad. The yarn is poor." You call the spinner, and he will say, "You don't give me repairs necessary for doing my work. My travellers are worn out. My spindles do not run true, and the rings are not true, and the roving is bad." You call your carder, and what does he say? He says he needs lots of repairs, and that you have not done any for a long time; besides, the cotton is poor and short stapled; and so it goes on with all that sort of talk. That is

the experience you have had more than a hundred times, every one of you. Such times and experiences as these come very often, especially in windy weather the same as to-day, when there is a great deal of frictional electricity in the rooms, and very dry.

If we do not know about these changes in humidity, the Signal Service reports will tell us accurately about them. I noticed their report in this morning's paper stated that the relative humidity yesterday noon was 100, last night 58 per cent.

In Boston the Signal Service report, for the year ending Aug. 31, that the relative humidity for the year was as follows, to wit: nine days between 10 and 20 per cent; eleven days between 20 and 30 per cent; fifty-six days between 30 and 40 per cent; seventy-seven days between 40 and 50 per cent; sixty-four days between 50 and 60 per cent; fifty-eight days between 60 and 70 per cent; eighteen days between 70 and 80 per cent; sixteen days between 80 and 90 per cent; and twenty-six days at 100 per cent, — showing that the relative humidity was three quarters of the time below 70 per cent. Please remember that 100 per cent denotes that the air is saturated with water, or has as much moisture as it can hold, as, in a rainy or foggy day, 50 or 60 or 70 means that the air has that per cent of saturation.

Away from the seashore, you will remember that it is much dryer than here, or by large bodies of water.

You will remember that the capacity of air to hold moisture increases as the temperature increases; for, with the thermometer at zero, the air can hold but half a grain of water to the cubic foot. At 40° it can hold but 2.9 grains to the cubic foot; at 50°, 4.29 grains; at 70°, 8 grains; at 90°, 14.8 grains. From this you will see that air at 70° temperature holds twice as much moisture as at 48°, and half as much as at 92° temperature. Now, if we suppose that the air out of doors is at 50° temperature, and has 60 per cent moisture, and you let it into your rooms, there heat it to 70° temperature, then you will have a relative humidity of only 32 per cent. We will suppose the same temperature of 50° in the out-of-doors air, but that it is saturated or has 100 per cent relative humidity; and let that into your rooms, and heat it to 70°, *then* you would only have a relative humidity in your rooms of 53 per cent. Thus you will see that it is not always a good plan to let even out-doors damp air into your rooms, expecting thereby to make them

damper; for you ought to and may have a better condition of moisture inside than the out-door air let in would give.

If 70° is about the right *temperature* to keep your rooms, at what *humidity* will you keep them? Can you tell? There is a right condition of humidity, one better than any other; who knows what it is? I have asked a great many manufacturers what humidity they keep in their rooms, and I have never got a definite answer.

To keep a regular humidity in your rooms, it must be done artificially, not depending on natural condition of the atmosphere.

From a large number of experiments extending through many years, I think I am warranted in saying that 70 per cent relative humidity is the proper and right condition of moisture for all processes of the cotton manufacture, to produce best results.

Another thing with regard to the air I meant to have spoken of before. If you keep your rooms at 70°, and have 70 per cent relative humidity, there will be 5.6 grains of water in each cubic foot of air. Now, if you increase the temperature to 80°, you must have 7.6 grains of water to the cubic foot, to maintain the required 70 per cent relative humidity. So you see it is not well to heat your rooms hotter than 70°, for you dry up the moisture; or, in other words, 70 per cent humidity at 70° temperature becomes only 51 per cent humidity when heated to 80° temperature.

All bearings and journals run with less friction and power in a moistened atmosphere. Spindles run with less power, and produce better work, if the bands are kept at a regular tension, consequent on regular humidity. The most of you have tried to moisten the air in your mills with steam, with indifferent success, and considerable damage and trouble, and sometimes perhaps at loss from fire by spontaneous combustion from hot steam-pipes. I advise all of you to see an example in Mr. Atkinson's office, where fire evidently took from a hot steam-pipe.

I doubt very much as to the benefit received in moistening air in your mills by blowing off steam; for while you were trying to moisten you heated the air more and more, and, the more heat you have, the more moisture is required.

The elder Mr. Johnston of Cohoes said, with regard to moist-

ening mills by blowing off steam, that he believed that steam let into a room, or steam in contact with cotton before it was got into cloth, was always injurious. He also said that no boy or girl of his should ever work in your Eastern mills, where they were kept so hot by blowing off steam in them.

Mr. J. F. Slater, into whose mill I put my apparatus, said that it was worth all it cost, in the comfort it gave to the help in relief from the extreme heat of the mills. Another says (and you will have to take what he says with considerable allowance) that his weaving-room, where my apparatus was in use, was the coolest place in the city. Actual record, however, shows that, in a mill having my apparatus, where they kept the record three or four times a day, the temperature was ten to fifteen degrees less during the heat of summer, and when lighted up, than in similarly situated rooms without the apparatus.

Spray from an atomizing tube is a great absorbent of electricity, water being a conductor next to metal in effectiveness, and especially water in globular form. In order to test its value in this respect, I put it in one of the best bleacheries in New England, where they were much troubled with electricity: as the cloth came from the drying cylinders, and passed down through the floor into the cloth-room, it would stick and cling to the trough, and pile up unless some one stood ready at such times to pull it down; and even when down it would puff up and full up so that one had to stand and press it down. After my apparatus was put in, the electricity was absorbed, and they had no further trouble in that respect; the manager writes me that it was working satisfactorily. Therefore I think my mode of moistening will be of great benefit in every department of your mills in this respect. I have here but a portable apparatus gotten up for a special purpose, and not for exhibition here. I will, however, try to illustrate the operation of my apparatus with it.

I run two lines of pipe, one five inches above the other, along by the posts in the centre of the room, — if not over fifty feet wide, — attaching the pipes to the posts about eight feet from the floor. The upper pipe conveys compressed air, the lower water. The water-pipe is supplied with water from a small tank set generally over the sink. Water is kept automatically at a regular height in the tank, and flows out through pipes to the cup-pipe located at the same height as the tank; water stands in

the cup-pipe to within seven-eighths of an inch of the cup; into this cup the water-arm of the atomizing tube is placed: the other arm of the tube is connected with the air-pipe, and supplied with compressed air as a motor to atomize the water, from an air pump. I use an atomizing tube similar to those your wives and daughters use for perfumery.

One compression air-pump may supply every room in your mill, but each room must have its separate water-tank, unless it is on the same level. You may dampen to any desired extent, 70 or 80 per cent or more, provided you give pressure enough, and have spray-tubes enough. I recommend 70 per cent relative humidity for every room in your mills, and think you would be great gainers to keep it there.

I use in my apparatus only fresh pure air from out of doors, and clean filtered water.

I will now show you how this apparatus operates. [Turns the crank, and exhibits the operation of the machine.]

There is a small air-pump in *here*, and a small water-pump *here*. One of these sprays throws from three to four gallons of water a day. In one mill I put one hundred sprays, and in another one hundred and ninety-two sprays. They are located along the room, eight, ten, or fifteen feet apart as required. One spray answers for about eight thirty-six-inch looms, or four hundred feet of floor space.

The PRESIDENT. I suppose, in accordance with ordinary custom, the gentleman will allow himself to be questioned, if any of the members desire to ask questions. He has made his explanations so full, and exhibited the invention so clearly, that perhaps every one will be satisfied. But, if any one has a question to ask, there is now opportunity.

Mr. THOMPSON. I would like to ask the gentleman whether the atmosphere outside, of the same temperature, always contains the same amount of water.

Mr. GARLAND. No, not at all.

Mr. THOMPSON. You did not explain that matter, I believe; and I rather gathered the impression that the air of a given temperature always contains the same amount of moisture.

Mr. GARLAND. No, sir.

Mr. THOMPSON. Then you cannot control the out-door air; and you claim more for this invention because by it you can make the humidity regular. Then you say you never got

definite answer from anybody as to what kind of atmosphere he had in his mill. I suppose a good many of the members would say that they could not exactly tell about the atmosphere. Now in regard to the cloth going down the trough that you mentioned; did you notice that the electricity made a good deal of trouble in respect to other matters in the same room?

Mr. GARLAND. It blows your beard and your hair out straight; after this apparatus was introduced, they would lie down.

Mr. THOMPSON. Was it the air that held up these folds of cloth, or was it the electricity?

Mr. GARLAND. They claimed that it was the electricity.

Mr. THOMPSON. Do you think it was the electricity which held that cloth up before the invention was put into the mill, or was it the air? The cloth becoming wetter would hold the air more, the same as in the case of the sail of a vessel, and hence the cloth would become more puffy.

Mr. GARLAND. Electricity, not air: that did not seem to be the effect there. It seemed to lie down well after the invention was put in.

Mr. THOMPSON. Did anybody have to push the cloth down after the invention was applied?

Mr. GARLAND. No, sir.

Mr. THOMPSON. Then you rather think that it facilitated that operation?

Mr. GARLAND. It seemed to; yes, sir.

Mr. ATKINSON. This apparatus attracted my attention, and I invited Mr. Garland to put it into our office. It seemed to me to be a perfectly good thing, and I was very glad to show it. I want to call the attention of those who have to deal with these questions of humidity and dryness, to the possible application of some of these figures to the other problem of "drying." The dry-houses and drying apparatus of the factories are to us underwriters the most dangerous points; and it appears by this statement that Mr. Garland has made, that the atmosphere at 90° has twice as much avidity for moisture as the atmosphere at 60° to 70°. Now, then, gentlemen, in a great many places where you have to deal with drying you can lay in ice a great deal cheaper than you can lay in coal; and it has occurred to me that it was incumbent upon some of you

to find out how to carry your outside atmosphere in summer through a big ice-chamber, in order to thoroughly dry the air and reduce the moisture in it before you carry it into your dry-houses or into your slashers; and that if you can devise such a method you will find that ice is a better dryer and a cheaper one than so much expenditure on coal, and that you will be able to keep your temperature down so as not to take your yarn and make it brittle and tender.

I would like to state at this point that I am desired by the Curator of the Art Museum to invite members of the Association to visit that institution at any time during their stay in this city. By giving their names at the door they will be admitted. The large central room is devoted to textiles: and perhaps some of the articles that you will inspect this afternoon will be placed there for exhibition.

The PRESIDENT. The next subject for consideration is a report from Mr. Atkinson upon the results of recent trials of hose, with a view to determining the best kinds for use: and he will also present a statement of the information desired for the United States census of 1880, relating to cotton manufactures.

Mr. ATKINSON. I will report in print upon the subject of hose. There has not been time to complete the trial since the notice was given. The delay has occurred because some gentlemen, experts in antiseptic work, have some new methods of preventing against mildew, that required a little time for experiments to be made. I think the report may be somewhat important when it comes, and I will report in print. In respect to the census, I will defer that until afternoon, in order to give way for the other work of the meeting. I will have several other subjects to bring in in the afternoon, but will give way now.

Mr. WARREN. I wish, if I may be permitted to do so, to call upon Mr. Atkinson for a paper which he has prepared before the close of this meeting, as to the extent of the manufacture and the use of hand-made fabrics of cotton.

Mr. ATKINSON. I want to call your attention to what Mr. Waite (who, I am happy to say, is a graduate of the Institute of Technology) has accomplished. At the last meeting, Mr. Ordway stated to you the difficulties with regard to every existing machine, without exception, that had been made for th

purpose of testing the comparative anti-frictional properties of oil, and you will notice that he condemned every one. We have since (not knowing, at the time we ordered it, of Mr. Waite's success) had made an expensive machine, on Mr. Ordway's design, which is now set up in the room where the looms are, and not yet tried. I want you to observe this, that, in adding to the mechanism the column of water, Mr. Waite has avoided all the previous difficulties. By this device absolute conditions of temperature in the operating parts of the machine are secured; and I understand him that in different atmospheres, and under different conditions, such as caused a great variation in all our trials with the other machines, he has obtained true comparisons. He gets results within one per cent whenever he tries. Therefore the science of lubrication has made a great step by this invention. He also brings before you the fact that the mineral oils are the best lubricants, and in every point confirms the deductions that have been made in Mr. Ordway's investigation. In respect to another point, it seems to me that Mr. Waite has made a very important step, and that is, that an extreme polish of bearing surfaces is a positive injury. He has stated to me, — what he omitted to state here, — that by carrying the polish of bearing surfaces beyond a certain given point, which appeared to be the true one, he has met seven times the resistance; i.e., using the same oil of the same temperature, and other things being equal, the carrying of the polish to an extremely fine degree has made the resistance seven times as great as on the comparatively rough surface. That is an extraordinary demonstration — if it is proved.

In this connection I desire to call your attention to another matter, — the *staining quality* of oil is a very important matter, one of the utmost consequence to you all, especially as the tendency is now towards the mineral oils. In the course of our investigation of oils, as we have named before, the acid test was applied to various animal oils; the nitro-sulphuric acid test was applied to animal oils to detect adulteration. The application of the same acid to mineral oils detected a variation in the quantity of a certain brown tarry gum. It appeared that there were different kinds of mineral oils, — some made by the distillation of petroleum, and others alleged to be made by filtration without distillation. I give you the

facts as stated to me. Whether they mean any thing, or not, will yet appear. There are certain oils that are claimed to be made by filtration, and others by distillation, and when the acid test was applied to distilled oils the brown tarry gum appeared; when applied to oils alleged to be filtered it did not appear. We therefore *guessed* — we did not *know* — that this gum might have something to do with the staining. I therefore requested parties to stain some printing cloths, to number them, and send them to three different bleacheries, — to stain them with filtered oils and with distilled paraffine oils and with sperm oils. We received reports in two cases, — the Norwich Bleachery and the Lewiston Bleachery. In one case the filtered oil was bleached out, the distilled oil was not bleached out, and the sperm oil showed some signs of stain. In the other case, the filtered oil and the sperm oil both bleached out, and the distilled oil did not. I then made the suggestion to various printers, at three of the largest print-works establishments, — to try the experiment; and their answer was, "Our process of bleaching is so complete and thorough that we had no difficulty in bleaching out any of the oils." I know that they use the distilled oils, — two of them at least, — and they do not fail to get it out of their cloths. Therefore this consideration has reference to the ordinary process of bleaching our common goods. But Mr. Dempsey came up, and said that I ought to be hung for inducing the use of mineral oils on looms for thick goods, that it was a very different problem when it came to thick goods, and that they could not bleach out mineral oils without injury to the cloth. Whether they can, or not, remains to be seen. I therefore procured a piece of the thickest satteen jean, a piece of the thickest brown drill, brought them down to the Institute, selected twenty different kinds of oil, padded the oil into them to the utmost, *worked* it in, did each up separately, and sent them to the Waltham Bleachery to be stitched in with cloth of the same kind, and put through the ordinary process of bleaching. One set I had baked for twelve hours. The other set were put into cold soap and water, and not baked. In respect to the two sets, there appears to be very little difference. None of the oils have been bleached out entirely, not even the sperm. In respect to the relative quality of the oils, whether they bleach out more or less, these samples will show. Here are the twenty that have been baked, and the

twenty that are unbaked. Each kind of oil is marked. They were numbered by cuts, so that the bleacher should not know. Each piece is now marked with the name of the oil that was used, or what purported to be the name. The oils that are said to be filtered appear to have bleached out more perfectly than those which are said to be distilled. They appear to have bleached out nearly as well as the pure sperm, if not quite; and the samples give certain indications, to say the least, of the relative staining qualities of the oils. On the whole, by this ordinary process of bleaching none of these oils were bleached out. But filtered oils were removed better than any of the other mineral oils. The one that is the best of all in this list is an oil that stands at 305° flash, and evaporates five per cent in twelve hours at 140°. Here are the two sets for you to examine. The oils are all marked on the samples, and you can look them over, and draw your own conclusions.

Mr. THOMPSON. I would like to ask if either of those stains was made upon the looms while weaving.

Mr. ATKINSON. No. In all these cases the oil is padded in.

Mr. THOMPSON. A gentleman came to me nine years ago, and wanted me to try mineral oil on my looms. I said, "I don't want to; we cannot get the stains out." He said we could. I told him to put some of the oil on some goods, and bleach it out. He did so, as was reported to me. He reported to me that he had had them thoroughly bleached. I then said to him, "I haven't any faith; but if you will send me some of the oil I will weave as many yards of cloth as you say, and will manage to spot it more than usual. I will have them take their fingers, and wipe some of the gudgeon grease and iron upon the cloth." Mr. Sayles reported to me that if he did not injure the cloth he could not bleach them. He had to take about two thirds of the wear out of the goods. If you take those oils, and put them upon the loom, and try it, with the iron, you find a chemical action takes place, the cause of which you cannot determine.

Mr. ATKINSON. It is said to make a great difference whether the oil is used upon a bearing, and has iron mixed with it. I noticed, in one of the mills, making the thickest Marseilles quilts, and using one of the distilled mineral oils, that one of the inspectors went over the oil spots, rubbed them with hard soap and cold water, and scoured them before they went

into the bleach; and those spots did bleach out, — though the oil spots came from the iron of the loom. They had not much trouble in bleaching them out. The process was carried through in the usual order. The quilts were taken from the loom, carried to the cloth-room, inspected in the usual manner, hard soap and cold water rubbed in, and scouring done by hand spot by spot. They then went into the bleach; and there is no stain upon them.

Mr. THOMPSON. Had that same quilt been cut off with the same spot, and laid away, and aged three or four months, the result might have been different.

Mr. ATKINSON. That we suspected, and to that end I had these goods baked, — in order that baking might take the place of the ageing. But there were no iron-brown oil stains, which it does appear are much more difficult to bleach. I have suggested to the agents of this quilt-mill to try these two kinds of oil, — to try the filtered oil without the inspection or washing by hand, to see if that comes out; and also to try the distilled oil, in order that the difference, if any, may be determined.

Mr. BARKER. I have had a little experience in that direction, the same as the gentleman has had about which he is now talking; and I find that where mineral oil is used on quilts, and the process of washing by hand is pursued, which is familiar to us at our place, still, let those quilts remain, and they will bleach out, so that as they come to the finisher, and are examined, you can scarcely discover any stain. But let that quilt lie for a month or six weeks, and it will show very much like the pieces that Mr. Atkinson has shown here to-day. The stain comes out again. My experience has been with mineral oil, that it is utterly impossible to bleach out any mineral oil that is made to-day, that I know any thing about, and save your goods. I have seen the fabric reduced to a pulp, and still you could see the effects after the goods lie for a while; the color comes back.

Mr. ATKINSON. We hope as underwriters that that will not be the result. It is clearly to your interest as manufacturers to get rid of friction by the use of mineral oil; it is our business as underwriters to get rid of animal oils, because they are liable to spontaneous combustion. I start with an animus in favor of mineral oils, that you may not burn.

Mr GOULDING. I feel like saying that this discussion brings

a subject prominently before us that needs to be remedied; and I have been working in the same direction. The difficulty in regard to having goods oiled comes largely from the bearings over the goods; the excess may be thrown upon the warps; but as a rule I think the staining comes from the bearings above. I would say here that when my bearings above the looms (where the work is not very severe on the bearings) have become worn, I have been replacing them with metalline, and have reduced the oil-stains very much. A large portion of the gentlemen here are making goods that have to be bleached. The design of the oil is to oil the machinery, and not the goods. I have labored hard to keep the oil from being put upon the goods, and to keep it upon the bearings.

Mr. ATKINSON. Mr. Barrows has stated an important fact, that, in respect to the oil tried at Willimantic that had not been on the bearings, the bleach was perfect; but that neither the sperm nor the mineral oil, after it had got a taint of iron in it, could be bleached out. The sperm operated the same as the mineral.

Mr. GARSED. In Philadelphia quite a number of cases were returned to the manufacturers all stained, that showed no stain at the time they were boxed up. The yarn was spun upon the cap-frame, and evidently was stained in the process of manufacture; and the same things have occurred to some of our New England manufacturers, who yet use a dead spindle by oiling it at the top. In confirmation of Mr. Waite's remark about water in oil, I would say that we have used in many of our mills a mixture in which we mix water with oil, and I think lime or some substance, to cool down our journals; and they are very successful indeed. It only confirms what the gentleman has discovered by actual experiment here.

Mr. THOMPSON. I have had a very large experience in heavy bearings and journals, in treating them where they have been heated, both in railroads and in turbine wheels; and this was my treatment. I never did any thing different, only when I had a hot journal I took a fine file, so called, — if it was rough much, or abrasion had taken place, I took a coarse file, — and went around it until I had got most of that off. Then I "draw-filed" lengthwise of the bearing, with a fine file; never applied emery-cloth, or any thing but a fine file. I never had one hot a second time after I had thus treated it.

Mr. WOODBURY. Mr. Waite has gained an important point by the use of a stream of water to keep his tester at a uniform temperature. I have had some experience with the various oil-testers in the market, and none of them will give uniform results with the same kind of oil; and I believe that the variations of temperature of the machines account for most of the errors; for the lubricating power of an oil varies with the temperature.

Last year I was making some experiments on a spinning-frame. The bands were arranged with a uniform and known tension, and a dynamometer was used to measure the power. At one time when the frame was running uniformly, I left the room for a moment; and when I returned found that the resistance of the frame had increased about fifty per cent. An assistant had opened a window, and the cold air had chilled the oil, with this result.

I believe that a mill should always be thoroughly warmed before starting, and that it does not pay to allow journals to be exposed to cold that will chill the oil.

Mr. WHITAKER. I had occasion in 1872 or 1873 to test four or five varieties of spinning-frames, at the Suffolk and Tremont Mills, for the purpose of settling a very delicate question. It was a question of the saving of power due to a changed method of banding. It was desirable to relieve the spindles from every source of irregularity in the power required to drive them, except that which grew out of the changed method of banding. I observed that, as is usual in such tests, the power required per spindle diminished after the spindles had been running for some time, and that if the spindles were stopped for a while, and then started again (apparently under exactly the same circumstances), the power required per spindle was always less, just before stopping, than just after starting. I also observed that if the bolsters were re-oiled, with oil of the temperature of the spinning-room, before they had become so dry that the power increased on account of insufficient lubrication, the re-oiling of itself increased the power required per spindle. I concluded that the change in the viscosity of the oil, which resulted from the increase of temperature due to the frictional resistance to the motion of the spindles, was the cause of the variations of power before referred to. I then had the spindles oiled regularly, once in ten minutes, with oil of the temperature of 212° Fahrenheit; and when this course was followed,

the variations of power were no longer noticeable. I do not know of any other tests of spinning-frames, where changes in the viscosity of the oil have not somewhat affected the results. In some cotton mills, about one-half of the entire power consumed is consumed in the spinning-rooms. I am convinced that a considerable percentage of the power consumed in the spinning-room (which in some cases is about one-half of that consumed in the entire mill) depends upon the viscosity of the oil, and that if a slightly viscous oil, such as Mr. Waite has pointed out, should be substituted in the spinning-room for some of the oils that are in common use, the saving of power would be noticeable.

The engine in my laboratory is of the Corliss type, and is at present regulated by an Allen governor.

The pulley shaft of the governor carries a paddle-wheel which is immersed in some fluid, such as oil, or a solution of some salt of soda in water. If the speed of the engine varies, the resistance to the rotation of the paddle-wheel in the fluid varies also, and this variation in the resistance is made to affect the cut-off by the means of suitable mechanism. When oil is the fluid used, the friction due to the motion of the paddle varies the temperature, and with it the viscosity of the oil; and, as the viscosity of the oil changes, the speed of the engine changes. For two or three years past, the chamber that contains the oil has been immersed in a small tank of slowly running water. The temperature, and the viscosity of the oil, are thus rendered quite uniform, and the speed of the engine regulated very perfectly.

Mr. WOODBURY. In those experiments that I referred to, I found that it took about two hours for the spinning-frame to heat up, so that the heat would be constant; and even then, any variation in the temperature of the room would alter the power.

The PRESIDENT. It will be borne in mind that we have a session this afternoon, commencing at two o'clock, and that the subject of consideration is "The Cause of Vibration in Factories or Machines, and its Remedy."

These fabrics on the tables are here for a purpose; and, as we have not been able to examine them this morning, or listen to remarks pertaining to them, they will be made the subject of examination and discussion after dinner, when it is hoped that

these subjects will induce a large number to attend. We have heretofore hurried over the business before the Association, because there was not time in the morning to consider the questions deliberately and properly; and hence at the last meeting it was determined to hold sessions hereafter both morning and afternoon.

Mr. ATKINSON. I would state that I shall bring before the Association after dinner William H. H. Whiting's electric gas-lighter, that can be carried around on the back, battery and all; the spindle-bands referred to at the last meeting; a concrete floor that can be laid and painted, and will bear the rolling of wheels and the like; a paint unaffected by acids or vapors, with which you can keep bleacheries and print-works bright; also the facts in relation to the census, the facts in relation to the hand-made fabrics of the world, the two kinds of safety-lamps for kerosene oil, and various plans for mills on the one-story principle.

[Recess till two o'clock P.M.]

On the re-assembling of the Association at two o'clock P.M., Mr. Atkinson addressed the Association upon the subject of

THE UNITED STATES CENSUS OF 1880 RELATING TO COTTON MANUFACTURE.

REMARKS OF MR. ATKINSON.

The taking of the census of this year, as you are probably aware, has been arranged, so far as the great leading interests are concerned, — of cotton, wool, iron, leather, and the like, — that there shall be some one special agent in charge of each department. I assume that the ordinary enumerators will do their work as usual. But all their work is to be checked off, and used as the material by which to correct, if it is necessary, the data compiled by the special agency. I have accepted the appointment of special agent to take a census of cotton-manufactures, print-works, and bleacheries. It occurred to me, that, as this was the tenth decade since the great inventions of Arkwright and the establishment of a factory system, it would be extremely desirable to get data in respect to the past as well as the present, — to prove the progress of the art of cotton spinning and weaving, in respect to the condition, payment, and

health of those who do the work. It appears by Mr. Burke's statement, submitted to you some time ago, that, as compared to 1838, one average operative produces three times as much cloth. In respect to the figures since 1860, there has been a decrease in the number of operatives to the thousand spindles, certainly of forty per cent; and that this decrease in number has been accompanied by an increase in the wages of those who continued to work, and a decrease in the cost of production, as we all are aware. In order to bring this into a definite shape, I prepared unofficial questions, and, with the authority of the census department, have been empowered to put these unofficial questions to those who are willing to do some work towards helping out this historic record. These questions imply a good deal of work for those who undertake to answer them. I therefore hope to be sustained, and I want those who are willing to undertake some statistical work in their respective factories to take copies of these unofficial questions, and give me answers in whole or in part; because, by the combination of all the answers that I shall receive, I think I shall be able to make out a sequence of events and a record of the progress and improvement, — not only progress in profit in the conduct of the business, but in the general improvement, and in respect to matters that have a very grave bearing on what is called the conflict of labor and capital. I therefore ask that those of you who are willing to undertake some of this work, and give me answers, will take from here the copies of the unofficial questions, and answer them. For information, I have also brought copies of the official questions which will be put just prior to the 1st of June of next year, to go with them. I will also take this opportunity to answer the question which Mr. Webber put. As a matter of very great interest in connection with the census, and with a view to the future market for fabrics made in this country, it occurred to me to work out the problem of the world's production of cotton and cotton cloth, and to see how much cotton was worked upon the machinery of the factories of Europe and America, and how much was still worked by hand; and I reached the conclusion, somewhat startling to myself and to most of those to whom I have named it, that the world's production of cotton is eleven to twelve millions of bales, of American weight, — certainly not less than ten million; that a little rising six millions of bales only are worked in

the factories of Europe and America combined; that the rest is still worked by hand; and that a larger portion of the population of the globe is clothed in hand-made fabrics than is yet clothed by machinery-made fabrics. I have brought here some sets of samples (these on this table) that were given to me by the Chinese Commissioners at the Centennial. *These* are the fabrics of China. These goods are the plain, narrow, heavy goods, dyed with vegetable dyes, and, as you see, dyed in a way that we cannot excel, if we can equal. These are the common wear of four hundred millions of people. Machine-made fabrics of Europe and America have not yet reached over thirty millions in China. If each Chinaman requires five pounds of cloth (as would appear to be the case from the best data to be obtained), it would take a second American crop of cotton of five million bales, to clothe the people of China.

These other fabrics to which I now direct your attention were received from the Commissioners of Education of Japan, — making a complete exhibit of the cotton-manufacture of Japan. They were received by me in exchange for one of the sample-cases which many of you joined in aiding me to put together and send over the world. I have not received as many responses to that sending, as I hoped; but some have come from extreme distances. Among them are these Japanese fabrics, hand-spun, hand-wove, and hand-printed. It is a complete exhibit, from the cotton in the seed. The rovings are in boxes, the yarns are on the table, and here are the fabrics.

Yonder are the fabrics of Brazil. Here are the costumes of India, with the fabrics of which they are composed. There are two hundred millions of people (of whose clothing those are the examples which you see before you) mainly clothed in cotton. These examples [referring to the figures clothed in illustration of costumes worn by distant nations] are well worthy of examination. These figures cost about twenty-five cents apiece in Bombay, where they were purchased for me. The duties and expenses of getting them here were a dollar apiece. I have lately had a letter stating that a Hindoo gentleman, being much interested in this undertaking, has packed a hundred more, and has sent them to me. There will be no cost for the effigies; they will be sent as a present; but, if it costs a dollar apiece for the incidental charges and expenses, I don't know but I shall have to ask the Association to join in aiding me in getting them through the custom-house.

Here is another assortment of the fabrics of Japan, sent to Professor Ordway, for the Institute of Technology, containing a very rare and curious collection of specimens of the fabrics, of various textures, made of cotton, silk, and other material. And here are very beautiful examples, a complete collection of the wall-papers of Japan, some of which are superb. The whole lesson of these examples is that there ought to be a systematic museum of textile fabrics here. I hope that this may become the nucleus of such a museum.

In connection with the census, and by authority of the Superintendent, I have prepared a very careful set of questions, tending to bring out all the information that can be obtained in respect to the hand-made cotton fabrics of the world. Those are to be sent to every consul and minister of the United States, with instructions to obtain the information, in answer to these carefully prepared questions, and to accompany the answers with three sets of pictures or photographs indicating the mode in which the goods are made up and worn, and three sets of samples of not less than half a yard in length each, and of the full width of the piece, and, where the head end is ornamented, consisting of the head ends. These instructions are now being printed, and will be sent out officially, as a part of the taking of the census of the cotton manufacture of the United States for 1880. I can see no reason to doubt that that order will bring together a collection of cotton fabrics such as probably does not exist elsewhere. One of those sets I hope may be at the disposal of the New England Cotton Manufacturers' Association, one is to go to the Smithsonian Institute, and one is to go into the archives of the census.

Now, gentlemen, another curious undertaking is under way. A sufficient sum of money is about being appropriated by an association to the publication of a work upon the manufactures, mechanic arts, and resources of the United States. That work is to be an octavo volume of a thousand pages, illustrated with steel engravings. It is to be printed in four languages, to pass through the State Department, to the different quarters of the globe. President Chadbourne of Williams College is editor-in-chief. I have been requested to write the article on cotton and cotton-manufactures; and it fell right into the line of census investigation and other investigation which I was pursuing. The article covers thirty pages. It contains more data than I have

ever put together before; and I suggest that it may possibly be of interest to the Association. At any rate, the Board of Government will decide that. I hesitate a little about it, because I have imposed so many things upon you; but you are at liberty, if the Board of Government see fit, to cause the first printing of this to be had in the report of this meeting. It is proposed to illustrate this work, not only with diagrams and descriptions of the best factories, but also diagrams and descriptions of the best American machinery; and the machine-makers will be called upon to furnish the drawings.

At the last meeting the subject of spinning-banding came up, and a reference was made to the bands which Mr. Woodbury had found in Oswego. They are made in England, and you observe that they are fastened by the little wire device. The band is adjusted by putting in a little more or less twist. If it is too long, put in a little more twist. It runs with exceeding smoothness. These are the bands intended for worsted spinning. I thought it worth your while to call your attention to them; and the advertisement of the agents in this country, Messrs. Stoddard and Lovering, is here. Here are the bands for your inspection.

CONCRETE FLOORS.

Mr. Atkinson. A good concrete floor that would not work into dust has been among the things that we have been seeking for a good while. Mr. William H. H. Whiting called my attention some time ago to the concrete floor laid in the basement of the Harmony Mills, and painted. It is made of the Neufchatel and Trinidad asphalt, laid on ordinary concrete. It appears to wear perfectly, not to create any dust, and to keep its coat of paint. I requested my friend Johnston to allow me to give an account of it, to repeat here. He says, "The flooring to which you refer is asphalt, almost identical with that used for paving, composed of Neufchatel nine-tenths, Trinidad one-tenth, with a small amount of clean sand. I am using this as a ground floor, and also as a top floor, in water-closets and places where ordinary wood floor is likely to decay. On plank floors I first lay a double thickness of roofing-paper.

"The material is cooked a while, so as to easily spread,—laid three-quarters of an inch to an inch thick. When cool, it will stand any weight. If it be painted it first requires a

coat of shellac, and then will take any ordinary color. For basement floors, cotton-rooms, damp places, and trucking, our experience of twelve months is most favorable for this material." [1]

This next sample of flooring has been prepared for me by the Warren Chemical & Manufacturing Company, who furnish the materials. It consists of Trinidad asphalt, and is cheaper than if it contained so much Neufchatel, and may suit the purpose fully as well. This has been for years a very desirable point to be covered.

BOSTON, Nov. 22, 1879.

EDWARD ATKINSON, ESQ.

Dear Sir, — At the late meeting of the Cotton Manufacturers' Association, in the course of your remarks on the subject of natural asphalt floors for mills, &c., which, for certain purposes, may be improved by a coat of light-colored paint, referring to such a floor at the Harmony Mills, Cohoes, N.Y., you observed that the surface of the asphalt floor was first covered with a coating of shellac, and then painted.

It appeared to me, from some little observation, and from a knowledge of the materials (though at the time my opinion was partly theoretical), that the coating of shellac was not only unnecessary, but that the paint would probably adhere more perfectly, and wear better, if applied directly on the surface of the asphalt. This opinion has since been confirmed by experiment. I find that paint will dry almost as quickly, and quite as well, applied directly on the asphalt surface, as even on wood. The reason why I think it will last longer so applied, without the intervening coat of shellac, is, that the paint-oil unites with the bitumen of the asphalt; and, being of a drying nature, which the bitumen is not, as soon as the paint-oil dries, the asphalt surface becomes just as hard and rigid as before; while, by the union of the two, a more perfect bond is formed of the paint with the asphalt surface, than can be formed when it is laid on an uncongenial surface, like shellac, with which the paint-oil cannot unite, and into which it cannot penetrate.

It has been proved, that by somewhat different manipulation, an equally good floor, and as free from dust, can be laid with Trinidad asphalt, as with that from Val de Travers, commonly called Neufchatel asphalt; while the cost is very much less. Such a floor can be put down over a plank floor, one inch in thickness, at about $1.25 per square yard; and an inch and a half in thickness, at about $1.50; and on earth, with rubble foundation, at $1.75 to $2.00 per square yard.

Yours truly,

SAML. M. WARREN.

At the same time, another invention has been just made, that has an important bearing on the keeping of dampness from premises, covering roofs, &c.; and that is an asphalt paper.

[1] Neufchatel Asphalte Co., 54 Astor House, New York.

This is a simple waterproof sheathing, consisting of two thicknesses of paper, and a thickness of asphalt between. It is furnished, I think, at six dollars a roll of a thousand square feet. It seems to me, that on single-brick walls, where there is liability to dampness, this may be placed, and a plastering put right over it. It is a new thing, worth calling your attention to.

Another thing very desirable has been a white paint that would not become black or discolored under the influence of the acids and alkalies of bleacheries, print-works, and the like, or under other hard conditions.

My attention has been called to what is called the "Griffith's Silicate White," very extensively noticed in the English papers, and so much advertised, that, although the evidence appeared to be absolutely conclusive of its use, it appeared to me to be overdone. I therefore asked Mr. Moses Pierce some months ago to procure from the New York agents a specimen of the Griffith's paint, and apply it in the hardest place in his bleachery, where it was most difficult to keep it white. He telegraphs me that Griffith's paint stands heat and moisture well. It appears to have been adopted by the English Admiralty in the painting of iron ships of war, and also appears to be used for ships that are employed for the conveying of sugar, which is the most severe test to which any paint can be put. I merely called your attention to it as a subject which might be interesting.

CARBURETTERS.

There is a tendency on the part of a good many manufacturers to economize in gas by the use of carburetters. Underwriters are very much afraid of naphtha, anywhere and under any conditions; and the first fire that occurs from a carburetter, if there does one occur, will put every carburetter out of Mutual offices. But, among carburetters, if you will insist upon trying them, we call attention to the one lately invented in Providence, — the Jackson carburetter, — and suggest that anybody contemplating the use of a carburetter at all shall look at the Jackson carburetter first.

At the same time, in "Engineering" I have found an account of the enrichment of coal-gas in England by what is called the "albo-carbon process," — enriching gas by the evaporation of a solid product of petroleum. Whatever the nature

of that product is, is matter of patent. But it is a solid product of petroleum, which evaporates under the impact of a current of coal-gas, and enriches the gas the same as the liquid and dangerous naphtha; and it is of course absolutely safe. I have put myself in correspondence with parties who represent it, and I suggest not putting in naphtha carburetters yet awhile, until we find out what this means.

One hundred and fifty factories are insured by us that burn kerosene oil. We have never had a loss from that cause, owing to the care that has been taken in the quality of the oil burned; but there are some unfit lamps in use still, and I want to get rid of them. I now show you the J. Payson Bradley lamp, which no careless handling can break, because the glass is entirely protected by the tin. It is sold by the Union Glass Company in Milk Street.

Also a lamp lately invented in Providence, known as the "Westland Safety Lamp," which is now on trial. The "globe" is double, and the space between the two partitions is charged with carbonic acid gas and water under a pressure of six pounds. They have tried to keep the lamp burning after breaking with the wick still in the oil, and after one hundred and twenty trials they have not succeeded yet in keeping it burning after breaking. The carbonic acid gas which comes from the breaking of the outer case puts out the fire. It appears to be a good thing. We do not indorse it: we only say to those who burn kerosene oil, "Try it."

Mr. DEMPSEY. What would be the effect if you broke the bottom part?

Mr. ATKINSON. It makes no difference. There is said to be enough gas condensed between these two surfaces to make a vapor that puts out this flame. They have tried one hundred and twenty times; and Mr. F. Whiting of the Mill-Owners' Office, who is now empowered to sell these lamps, is presently going to break one hundred of them here, under the control of experts, and see if it is possible to keep one burning after breaking.

In showing you the asphalt paper, I should have exhibited this specimen. *This* is a cone made of asphalt paper, by pinching up. It has been full of water for nearly a week, and there is not the slightest show of dampness on the outside yet. It appears to be absolutely impervious.

A MEMBER. Is the odor part of the paper?

Mr. ATKINSON. There is a slight odor of sulphur, but that evaporates and disappears, I am told. Understand me, I am not indorsing any of these things. In our business these matters keep coming before us; and this seems a proper place to call attention to them, in order that they may be tried. We do not indorse any of them.

PLANS FOR CONSTRUCTING MILLS.

The last subject to which I shall advert has reference to these various plans you see before you. As it is probable that there may be new mills soon being constructed, and in connection with the subject of the vibration of mills, we call your attention to that plan which is displayed upon the wall, which is the Renfrew Manufacturing Company's one-story mill. The larger building is a building covering an acre, the small one three-quarters. The cost is fifty cents a square foot of floor surface, and the looms are in operation at ten per cent higher speed than the same looms could be operated at on the second floor of the old mill, with less repairs and less imperfect work. The advantage is, that it is paying the interest on its cost in the gas which is saved, costing no more to heat, and being no hotter in summer, by actual experiment, than the second floor of the old mill, although in the weave-room all the machinery was in operation, and on the second floor, on the days of the observation, there was no machinery in operation.

The PRESIDENT. Before you go from there, I would like to ask one question. That idea of ten per cent additional speed would naturally strike all of us manufacturers as an important item. You say it will bear ten per cent higher speed on that floor than it would in the second story of the old mill?

Mr. ATKINSON. Yes, sir.

The PRESIDENT. What was the old mill?

Mr. ATKINSON. It is a brick mill, not of the very best sort, as I understand it, and not perhaps as good as you would now build.

The PRESIDENT. That is a very important item. The question is whether the second story, or the way in which the building was constructed, was what caused it.

Mr. ATKINSON. I suppose the mere suggestion will induce investigation. I don't understand that old mill to be as thor

oughly and adequately constructed as mills probably would be built to-day; but there is the fact, and it is an important one in its bearings. With a view to this, for a text-book that I am preparing, we have had that plan made of a one-story factory of 16,000 spindles, to be arranged on the "Greek cross" principle, like that picture, or in the "H-form," as the plan is put up upon the wall. I am going to have that reduced to a photograph.

ROOFS.

The matter of roofs is one with which you, gentlemen, appear to have more trouble than with any other; and the right method of constructing a truss appears to be often overlooked. To say the least, there appears to be a good deal of trouble with them. I have therefore had that plan of a truss computed by Edward S. Philbrick, a competent engineer, with complete description and detail for use. I intend to have that photographed, and any member who desires a copy of that can have it. Of course it can be reduced proportionately for any building. The width is 72 feet in the clear. That may be depended upon as absolutely safe.

VIBRATION IN MILLS.

The subject of vibration was made the theme of a communication to "The American Architect," in which a discussion has been going on for some few months on the comparative merits of combustible and incombustible construction; and it drew out a suggestion of a mode of checking the vibration in mills that are not very strong, which mode it seemed worth while to picture and bring before you, and there it is. The idea is that one beam is on the top of the other in this case; but I think it would be effected even on a solid beam, by diagonal bracing on each side of the beam. Actual tests have proved that the breaking strain was about equal to a solid timber, and the beam itself was a great deal stiffer than solid timber, and would not sag. In the course of that discussion the manufacturers, or rather the underwriters, have been held responsible by the architects for an alleged dreary appearance of factory buildings, and the absence of architectural effects where there was an excellent opportunity to give architectural effects. Whether that criticism is well grounded, or not, you are best able to judge. The response to that charge has been that the archi-

tects as a rule have not qualified themselves so adequately in the right method of constructing buildings as to have been often called upon; but as they alleged that we had not built any buildings that were architecturally good, but very dreary and very plain, I suggested to one of our young men to plan an ideal mill that should meet the conditions of good architectural effect, the requirement of the Mutual offices, the most adequate strength of wall with the least amount of brick to be used, and in every way be an example, — of a three-story or a four-story construction, and of a one-story construction. The picture is *there* in perspective and plan, on the wall before you. That I have had photographed at my own expense. That is not official; and, if anybody wants to build that mill, I can give them a chance.

Here before you is a little device in the shape of an automatic hatchway. There are many places where you want a hatchway, where you cannot get any self-closing hatchway, owing to the construction of the mill. The idea is that this hatch shall be held by links made of the same soft metal used in the automatic fire-extinguisher. *Here* is the hatch. *Here* is the soft metal joint, and below the floor here are three more. I can melt those links over a lamp, inside of a lock of raw cotton, without scorching the cotton. A fire in almost any part of a room will melt the links, and drop the hatch, without any question.

The last thing that we have to call your attention to is William H. H. Whiting's portable electric gas-lighter. In relation to all these matters, where there is any member connected with the Mutual system of insurance that has any interest, direct or indirect, in a patent, it will be stated. This is Mr. Whiting's patent, but it has the entire approval of the offices and companies, because it inures to safety. I do not want the slightest suspicion to rest against anybody of introducing any thing here, where any member has any interest in a patent, without its being stated. I do not propose myself to have any interest in any whatever; and therefore I state it frankly that we as officers heartily approve of this patent, and do not think that Mr. Whiting should be precluded from its introduction because he is an officer of a Mutual company.

On the wall yonder is a little mill at Ipswich for knitting. There they have very tall machines, which are very subject to

vibration. They find an enormous advantage in the steadiness of the one-story construction, for that class of machinery. You observe that the object of the underwriters is to get you all so that you cannot possibly burn, and then you will be first-rate men to insure.

A MEMBER. What would you do if you were going to build a mill where land was worth sixty cents a foot?

Mr. ATKINSON. I would go somewhere else.

A MEMBER. You would have to take your water-privilege and your dam with you in order to do that.

Mr. GARSED. Go to Pennsylvania, where they don't want any water.

Mr. NOURSE. I want to ask a question in regard to that lighting by the Renfrew Manufacturing Company. I understood him that in consequence of the building being one story, the saving in the consumption of gas over that in ordinary mills paid the interest on the cost.

Mr. ATKINSON. Yes, sir, I am stating the exact facts. The floor is forty-five thousand square feet. It cost about twenty-three thousand dollars ready for machinery. It is six feet clear in the basement, shafted from below. It is built of brick, and has the Monitor light and ventilation. It is occupied by gingham looms, which require usually a great excess of gas.

The daylight coming through the Monitor lights lasts so much longer, that the delay in lighting gas bought of the town of North Adams at the ordinary price of gas amounted in one winter to a saving equal to the interest on the cost of the building. Mr. Renfrew has given me these statements.

Mr. NOURSE. We are trying the electric light at the Globe Mill, Woonsocket; and I wanted to get all the information I could in relation to the lighting of mills, so that we could make the comparison, and see which was the cheapest light for us to use.

Mr. ATKINSON. I hope the electric light will be cheaper than any kind of gas. I have not seen it proved yet. I suspect that it will yet beat all gas purchased of gas companies. Whether it will be cheaper than oil gas made by the mill-owners themselves, is a question yet to be proved. So far as I have investigated the electric light, I have reason to suppose this: that where a mill buys town gas, and pays from two to three dollars a thousand feet, that gas is much dearer than the electric light as now fur-

nished. I have reason to suppose that, but I may be wrong. I have otherwise reason to suppose that where a mill makes its own gas from oil, at a cost not exceeding sixty cents to a dollar a thousand feet (as I believe we did at Indian Orchard), it is now doubtful whether the electric light beats that in cheapness.

Mr. CUMNOCK. Does that include the cost of gas-works, or just the bare running of it?

Mr. ATKINSON. I have the impression that sixty cents would include the interest on the cost of the works. We altered over the coal-gas works that we originally built there, to oil-gas works. I should like to have Mr. Goodwin state those figures of the cost of his gas last winter.

Mr. GOODWIN. I cannot state it exactly. The total cost for six months was $690. We burned 1,288 burners.

Mr. ATKINSON. I think it was $620 for the season with 1,288 burners. One of the basement rooms was very dark. That was the cost of labor and materials and repairs. We did not include interest on the works.

The PRESIDENT. What six months was that?

Mr. ATKINSON. It was last winter.

Mr. LUCIUS BRIGGS. In regard to the cost of oil gas, I made a very careful test in the improved works of the Providence Steam and Gas Pipe Company. Exclusive of interest on investment, it amounted to $1.29 after being diluted with air so as not to smoke.

The experiment was tried in lighting a mill of 60,000 spindles, which certainly was on a scale sufficiently large to be a fair test.

Mr. CUMNOCK. I went to a first-class concern, and asked them about it; and they made their gas cost $1.11, without any interest on the cost of the works.

Mr. ATKINSON. I had a very strong impression that it could be made for sixty cents a thousand feet, and I believe that it is correct. I had no intention of bringing that point in, at this time.

[At this point the portable electric gas-light apparatus, and the working of the same, were exhibited and illustrated in presence of the Association.]

Mr. ATKINSON. You will perceive that there is no cartridge, nothing to break and fall. It is nothing but the wire brush and the electric spark. I would state, gentlemen, the intention

to have the drawings and some of these other matters heliotyped, and of course the Association can have any of them put into the report if they want to, at cost. The small ones cost a few cents apiece, and the big ones I believe cost about fifteen cents apiece. If they are not used in the report, I can furnish copies to any member, who wishes to make use of them at any time.

That ends my long chapter, and I hope I shall now be excused.

The PRESIDENT. If any thing has occurred to any gentleman that they desire to say (unless there are parties who wish to talk particularly upon the matters last up), the meeting will be thrown open for discussion upon any subject which has been brought before us to-day.

Mr. ATKINSON. It is suggested that a little explanation of this electric lighting apparatus is required. All the explanation there is about it is to say that here is a little sal-ammoniac battery inside of this case (and one charge will last twelve months) connected by wires with the two poles of the gas-lighter.

The PRESIDENT. That seems to operate so successfully, and to possess such decided merit, that I imagine that gentlemen here who are manufacturers and owners of mills will be likely to make further inquiry, and ascertain all such facts as they may need to know, and that a great many of them will be likely to order it, — unless they discover something about this exhibition which I do not.

I would suggest to Mr. Atkinson that the question of "Vibration in Factories and Machines," which is on the circular, has not been particularly presented; and ask the question whether he was not intending to discuss it further, or whether the simple allusion to that Renfrew mill, where there was a difference of ten per cent in the speed, covered that?

Mr. ATKINSON. As I suggested that item to the Board of Government, I will state that, as you remember, the experiments on a single spinning-frame developed a very curious law of vibration, — a sideway vibration growing out of the rotary motions of the machine. That led our young men, as they were going about from mill to mill, to try to observe the varying conditions of vibration. It must be patent to every one, that if a large vibration exists, either in mill or machinery, there must

be a great expenditure of power in getting that mill into motion, and then a very great wear upon machinery while the mill is in such motion. I am only competent to state the elements of the problem. I have here a little article which I communicated to "The American Architect" on that subject, of which copies can be distributed, and can be included in this publication, as part of the report, if you think it is worth it. I have stated some of the curious facts that have been observed in respect to the vibration of apparently the strongest buildings. One of the most curious cases was that of a stone flax-mill, with arched brick floors, down in New Jersey, of the regular fire-proof English construction, in which a gas-jet was vibrating from the second floor. It was in continual motion with the operation of the machinery. As I have gone about from mill to mill, I have observed that spinning-frames in some mills will ring with a constant "*buzz-z-z-z-z.*" You will feel it really going at a tremendous rate, even on new frames. Go to another part of the mill, and they are still. It has something to do either with the construction or with the mode of building — I don't know which: I am not competent to tell. Go into another mill where there are old frames, twenty years old, and in very excellent condition at twenty years old, and you cannot feel the sensation in the frame, although the mill is not what we would build now — it is one that I used to have charge of. There is a cause for this, certainly; and I suspect that the cause is to be found in every building's having its key-note, and that if the revolutions of your machines, or a large portion of those machines, strike that key-note, your whole concern begins to vibrate; it certainly seems to be worth a continued series of observations. I think that Mr. Woodbury had better give you some facts that he has observed. These papers, if you care for them, give a computation for the dead weight of machinery in each department.

Mr. CUMNOCK. Mr. Atkinson has again called our attention to a most important subject, — the vibration of mills.

He raises the point that, in some of the mills he has called our attention to, his men found that some of the spinning-frames were running still, without any perceptible motion, and no apparent motion in the mill; while one hundred feet or more from this place, in the same mill, the spinning-frames had a perceptible motion, and the mill also. Now, from this

statement the vibration could not be charged to the mill itself, as it gave evidence in some parts at least that it had strength enough, and was well secured to avoid vibration.

If the spinning-frames were running steadily in one part of the mill, and in another part one hundred feet distant there was apparent motion, that fault, in my opinion, was not in the mill, but could be found, I think, in unbalanced cylinders on the spinning-frames.

In passing through a mill not long since, my attention was called to this very fact.

I noticed that there was considerable motion in one part of the mill, and some little distance off there was no apparent motion. I called the attention of the agent to the fact: he said he was aware of it, but had not been able to find the cause. I noticed the motion was uniform. The shafting in the mill was running at a high rate of speed; three hundred and twenty revolutions in the card-room, two hundred and eighty in the weaving, and four hundred in the spinning-room. On the last shaft mentioned, there were two 48-inch pulleys, 24-inch face, running. In standing over them I made up my mind that they were out of balance. I asked the agent to balance them, and see if the uniform wavelet of motion from this point would not cease. He did so, and the vibration of floors and wall ceased.

This may seem strange to some of the gentlemen present, but on second thought you will see it is in keeping with laws of motion.

A regiment of soldiers go over a bridge, and break step, with little or no motion to the structure; cause, broken motion: whereas a dog, on a uniform trot across, will shake the whole structure.

A pulley unbalanced in the mill, or a spinning-drum running at a high rate of speed unbalanced, will give a uniform motion to every thing in contact with it; and, when fastened to beam or floor, will give the motion to the floors and walls in wavelets.

If manufacturers would give more attention to the balancing of pulleys, and machine-makers more attention to balancing the drums, in spinning-frames, the vibration, to a very large extent, in mills would cease.

As to weaving, it is impossible, where two stories of weaving run in the same mill, to run the mill without more or less vibration.

The reason is that all looms have dead points as the crank-shaft revolves; there is a throw that cannot be overcome as long as a crank is used for motion. However, the vibration of the mill from the throw of the looms can be reduced very much by breaking the motion. Say 145 picks per minute to be the speed: run every other row of looms three picks above that speed, or below, thus breaking the motion, and the vibration of the mill will be sensibly diminished.

Mr. ATKINSON. I wish to call your attention to the difference between the vibration of the mill, and oscillation of the parts. I think that Mr. Cumnock's explanation will account for oscillation. But there is a law of vibration aside from that, and some of the facts that Mr. Woodbury has observed go far to indicate its nature.

Mr. WOODBURY. Before citing any examples of the jarring of mills, I desire to call your attention to the character of such motions, and to the difference between oscillation and vibration; and then, with this distinction and its causes understood, we will consider a few cases of the vibration of factories, and the nature of the remedy.

The motion of a pulsating body is either oscillation or vibration: the first being caused by external forces; and the second the consequence of forces, one of which is the cohesive force within the body, binding its molecules together, and dependent for its character upon the elasticity of the body. To illustrate: if a suspended wire is struck, the forces of the blow and of gravitation cause it to oscillate; if the same wire is strained between two points, the forces of the blow and of elasticity cause it to vibrate.

The rapidity of this vibration is governed by the dimensions, elasticity, and tension of the body; and every mass will vibrate at a constant velocity, whenever that vibration is produced by adequate causes and conditions. Not only every piano-forte wire and organ pipe, but every bridge and factory, has its key-note. As the vibrations of the communicating air will force the piano or organ to answer in harmonious response to the tone of the voice, so the structure will reply to the proper vibratory force.

The shaking of a mill is chiefly limited to the vibration of the elastic floor and beams; while the swaying of the whole building is generally caused by oscillation. Both of these

motions appear in the same building; but oscillation is due to poor construction, while vibration is produced by impulses synchronous with the key-note of the building, and bears no relation to the solidity of construction. In a certain district of New England, many factories were built during the war, when high prices, haste for completion, and perhaps limited capital, resulted in poorly constructed buildings. Shabbiness prevails everywhere: the walls are too light, the beams too small, and the floor-planks too thin, when compared with structures built by our leading engineers as standards.

In many instances the weight of the machinery has deflected the floors several inches, and in others additional columns have been necessary to keep the floors level. The oscillation of these mills was excessive, but I do not recall an instance of extreme vibration.

In the practical construction of machinery, the revolving portions are not *absolutely* balanced; and when one considers the immense weight of revolving parts of mill machinery, and its velocity, it seems as if the aggregation of unbalanced centrifugal forces would overturn, instead of merely jar, a mill; and such a destructive result would undoubtedly ensue if these irregularities acted in unison, instead of opposing each other.

Let us consider the characteristics of a vibrating mill floor by comparison with those of a metal plate when vibrating under conditions which are simple and easily controlled. If a metal plate is supported at the centre, and a violin bow be drawn across the edge, the plate will not vibrate as a whole, but in divisions, which are readily distinguished if sand has been dusted on the plate, as the vibrating portions will jar the sand to the nodes or dividing lines which are at rest. If the plate is a square one, and the bow drawn at the corner while the free vibration is damped by resting the finger at one side midway between the two corners, the sand will gather in two lines, dividing the plate into four equal squares; if the bow is drawn at the middle of one side, and the finger placed at one of the corners, the ridges of sand will divide the plate along the two diagonals extending from corner to corner; and, by varying the positions of the damping points and the bow, the nodal divisions resolve into complex and curious curves and lines. A vibrating mill floor is under similar conditions, except that the contact of pillars and surrounding walls, as far as they

restrain free vibration, complicate the details of these vibrating divisions, beyond the power of analysis, except to show that the vibration of the floor is separated into numerous and irregular divisions.

The effect of these forces has been observed in many factories, and for examples I would refer you to the ring spinning-rooms, where the frames are of the same manufacture, and supposed to be operating under identical conditions: some of them will shake violently, while others beside them run as steadily as could be desired.

Some of the gas-pipes extending from the ceiling in the upper story of a flat-roofed mill were observed to be in motion, while others were stationary, showing some of the divisions in the vibrations of the roof. On account of their rigidity, gas-pipes do not indicate the divisions of vibration as sensitively as hanging lamps. In a mill at Haydenville, Mass., the vertical motion of certain hanging lamps showed that there was a vibration of the floor amounting to an inch in some places. Other lamps moved less, and some were still.

One of the most delicate indications was in the unoccupied attic of a mill at Exeter, N.H., where the agent had judiciously placed upon the floor numerous fire-pails filled with water. The surfaces moved in unison with the vibration of the floor, generally swaying, some traversed by successive lines of waves whose direction varied in different pails; others, evidently over nodal lines, were at rest; while a few, which were situated upon centres of vibration, were covered with ripples such as are produced when a hanging pail of water is struck underneath. Of two pails situated within a foot of each other, one indicated by its ripples that its position was over a centre of greatest vibration, while the other showed by its wave-like motion that its location was near such a point of greatest vibration, but not over it. The vibrations of the floor are in waves, moving up and down without any progression, and the character of the motions of the water in these pails was concurrent with such action.

It is well known that some notes on a church organ will cause only certain portions of that church to vibrate. I have been informed that in some portions of the picker building of a Woonsocket mill, the vibration jarred the dust to the nodal lines, showing the divisions clearly.

Although these areas of vibration are modified by the columns and walls, yet they are not coincident with any divisions of the floor, because excessive vibration has been observed near such places, while the portions away from such support were at rest; but the reverse is generally the case, and the most perfect repose is near the points of greatest stability, where one would naturally expect to find it.

The superintendent of a New Hampshire mill, when in the factory on Sunday, was greatly surprised at the shaking of the building. He observed that the water was flowing in broken sheets over the dam, and presumed that the pulsations of air were synchronous with the key-note of the mill; continuing his observations, he learned that with a greater or smaller flow of water over the dam, the mill was at rest; and also, with the scuttle in the roof open, so that the puffs of outside air were in free communication with the interior of the mill, the vibration was much greater than when the scuttle was closed.

At Centredale, R.I., the water flowing over the dam caused at times a great vibration in the mill. This has been stopped by fastening vertical pieces of plank, at intervals of ten feet, against the front of the dam, and projecting upwards so as to break the long sheet of water into numerous short falls, whose key-note was different from that of the whole sheet of water which they displaced.

At the Essex Woollen Co., mill number eight is sometimes thrown into vibration by the water flowing over the dam; and, when this happens, the watchman on duty alters the note of the dam by opening the waste-gate, and the mill soon comes to rest. Mill number five of the same company, but at a privilege lower down the stream, is often thrown into vibration by the falling water at that point; and the story is told, that a watchman once fled from that mill, thinking that it was about to fall.

Of the eleven mills owned by this corporation, I have been told that none of the others vibrate from the above cause. When in operation, mill number six was often thrown into vibration by the motion of the machinery.

When vibrations are due to machinery, they are stopped by changing the speed.

At the Merrimac Mills, Lowell, and many other places, this method has been successful. It is unnecessary to cite further examples; but in all cases vibrations are noticed when some

adequate cause is sounding the key-note: if the velocity of these pulsations is altered, the vibrations due to that identical cause will cease.

The consequences of mill vibration, in the power absorbed by its exertion, in the continual straining of machinery and mill, must inevitably tend to damaging results to plant and product.

Were not a lot of columns placed almost at random out of the question in a mill, we could make the statement that vibration could be diminished and nearly stopped by placing columns under the principal centres of vibration, and so divide the floor into still smaller areas of vibration.

The only sure method of prevention applicable to the future seems to lie in the construction of one-story mills, with the shafting resting upon piers in the basement. The result in the additional speed without any disturbance of stability, and of the diminution of the repairs under the same excessive conditions in mills constructed upon the one-story plan, will hasten their introduction. In such a mill, if vibration should take place, it could be stopped by additional columns in the low basement without interfering with the machinery.

The swaying of a mill owing to oscillation is due to a lack of stability, and weak construction; and the only correction possible for such cases is to increase the strength by reconstruction of weak portions of the building.

Mr. GARSED. While we are on the subject of one-story mills, I must tell a story of my own. In 1853 we built a one-story mill in Philadelphia. It was sixty-six feet on the inside, and five hundred feet long. We built it upon the ground. We did not put any posts under it, or any basement. We simply went along in a democratic manner, and built a mill, and put blocks of stone, and set machinery on the blocks of stone, as there was no basement. It was set on the earth. We did not have any vibration, of course, and we have not to-day. I got up to give you the exact facts. For twenty-six years that mill has been running; and to-day there is no vibration from the machinery, except that which is in the machinery itself. An unbalanced cylinder or an unbalanced pulley will make a frame vibrate, I don't care what frame it is. But the drawback to a one-story mill in our climate appears to be the objection of work-people to walk upon stone, whether it is from the damp-

ness or the rigidity. But I would build a one-story mill again, only I would make the walks of wood. I would put the machinery upon stone, but would never run the risk again to get spinners to work upon a stone floor; though it is a very common thing to do in England.

Mr. ATKINSON. This asphalt flooring is a non-conductor of heat, and therefore will remedy all that difficulty.

Mr. GARSED. But there seems to be a want of elasticity to it where people are walking over it all day in a very warm building. I don't know why it is so; but I have made up my mind that I will never again undertake to have a stone floor in any mill in America. If you make a concrete floor, and sink boards one inch below the top of the concrete, and, when the floor rots out, pick up these pieces, and substitute a new one, you will have no difficulty. If your mill is built upon the ground, put your machinery upon blocks of stone, with a piece of leather between the foot of the machinery and the stone, or a piece of sheet-lead. There will be no danger of vibration of the mill, and none whatever of its burning down. But I must say that our experience has not justified the conclusion that it does not take any more heat in winter, and that it is as cool in summer as any other. It does take more heat in winter, and we find it uncomfortably warm in summer.

Mr. ATKINSON. How thick is the wood of the roof?

Mr. GARSED. It is plain inch planks, covered with felting and white gravel.

Mr. ATKINSON. That marks the difference between a one-inch and a three-inch roofing-plank. The three-inch plank for the roof will keep the one-story mill warm in winter and cool in summer, and will prevent the condensation of moisture on the inside. In Mr. Johnston's weaving-room, he screws his looms right down into this asphalt material.

Mr. GARSED. We bore a hole into the stone, fill with lead, and put an ordinary wood screw into it, the same as you would upon a floor.

Mr. BIRKENHEAD. In Mr. Cumnock's remarks as to the effect of want of balanced pulleys, if he had taken a piece of chalk, and held it near the face of said pulley, he would have noticed the mark left by the chalk would indicate two things worthy of knowing: first, the exact location of the heavy side of the pulley; second, the wear on the shaft in the bearing nearest the pulley,

which, if run a long time, would wear the journal to a form between that of the letters O and D: what is generally known as a flat place; but this convex coincides with the circle of the bearing which is formed by the frictional contact of the circle of the bearing. It is very clear, if the heavy side is always in a line or opposite to the face of this wear, or, in other words, the excess of weight on the pulley, and wear on the shaft, both are on same side, — this being the case, the excess of weight must be the cause of the wear. If it is, let us see how this wear takes place. In the first place, the heavy side is the controlling power: the energy of this power is directed outwards, multiplied by its weight and velocity, as it were: the force keeping one side of the shaft constantly in frictional contact with the inner surface of the bearing, instead of a natural revolving contact, there results a sort of scraping or eccentric motion. Now, it will be seen from this, there is no ground for the old idea of hard and soft places in metal, which seems to be an accepted belief by many; the law being a natural one, hence a positive one, results in producing a flattened surface. There is iron that contains hard and soft places, but not in a form that causes a shaft to wear out of round, by any means; for when this is seen in iron it has the appearance of a piece of cordwood, or a fluted roll, or the grain of wood. Lowmoor, and other fine grades of iron, are free from *such*. Hard and soft places are sometimes found in machinery-steel, caused, I should say, by want of carbon in the soft places. Tool steel contains more carbon, hence is not so liable to have soft places. Spindle-steel contains an excess of carbon above tool or machinery steel. There seems to be no limit to the amount of carbon which steel will take. The Mushet steel, for instance, is harder than hardened steel without the chilling process. In speaking of the uneven wear of shafts, you, no doubt, have noticed flat places on spindles, illustrating the same fact. The causes are these: if the bolster-bearing is flat-sided, the spindle top or blade is bent, or imperfectly straightened, producing a heavy side on the side of the flattening surface. If the quill is out of balance, it will have an eccentric motion, the same as an imperfect spindle, but is not likely to form a flat place, for the reason that the quill is being constantly changed in doffing, otherwise a flat place would result. Having thus explained the cause of wear in the bolster-bearing; the flat place in the

foot or step-bearing is caused when the butt is out of balance, through an excess of weight on one side of the extreme cone or V point of the foot, as the point is its balancing centre; and when an eccentric motion is produced becomes worn still more towards the light side, causing the heavy side to become still heavier. You will naturally infer after this statement, or ask the question, Why does not the band keep it up to a bearing? To this I would say, it has no more power to do so than a belt on a shaft, when the pulley is out of balance; for the throw is so great, the band, with a pull of four or more pounds pressure, has no control over it. What is called a vibration in a spindle is not an indiscriminate rattling about, as it appears; any more than a shaft rattles about. It is a rapid, eccentric motion, uniform in its action. It has an artificial centre, and revolves around it. It requires skill to make a good spindle. It makes but little difference how or where you support a spindle; if it is out of balance its life is short, whether light or heavy, or whether it is hard or soft; the result will be the same, if it is out of balance. The law of eccentricity will destroy it, support it where you will; you may stop its appearance, but not its effect.

This has been my experience in the matter for years, and I have endeavored to improve the mode of making spindles, so that inferior work will be less liable to be made. Permit me to suggest here the survival of the fittest. I leave you to decide. I think the time has come for you to ask whose spindle has survived. To speak for myself, I say I have not received an order for, neither have I made, a spindle to replace a worn-out one, nor have I repaired one, since I commenced to make light spindles.

Mr. GOULDING. It occurred to me while the discussion was going on, that those who were paying for coal to make steam to move machinery had enough to do to furnish to run the machinery, without furnishing power to shake the mill and heavy arches. We ought to impress this lesson on our minds, that machinery should be so built as not to have to furnish sufficient power to vibrate the whole building. No one can deny that we have it. We can most of us tell what it is that causes the shaking. Mills may be so placed that it is almost inevitable that the mill should shake from the motion of the looms. Suggestion has been made to put in more posts or timbers. That is

not going to prevent using power sufficient to shake the mill. We may make the mill strong, so as not to feel it. Let us go back to first principles, and make the machinery so perfect that we shall only have to furnish power to run the machinery, not to shake the mill.

Mr. GARSED. If you move a pulley upon the shaft, nine times out of ten it will throw that out of line, and produce a vibration, precisely the same as if it was struck by some object. To illustrate: we use a block spooler. I tried to have the hole sufficiently accurate, and the shaft ground with sufficient accuracy, so as not to disturb the alignement of the shaft when the pulleys were moved. The only way we got it was to set the pulleys, and turn them off with a lathe. If you set the shaft with two set screws, the chances are, you will disturb the alignement sufficiently to produce a vibration. You see the difficulty, when you come down to scientific points.

Mr. BIRKENHEAD. I would say, in regard to vibration in spindles, that the term is misemployed: eccentricity, I think, would convey the meaning better. Vibration means the oscillation of a body to and fro in rapid succession. An eccentric motion will produce vibration in the machine in which it revolves. It seems strange that vibration should be caused in a spinning frame by the action of so many spindles. I favor Mr. ATMORE's remarks, in speaking of the key-note, which I think accounts for it, just the same as a mill is shaken by the action of the beams. When a spinning-frame cylinder is out of balance, it being the heaviest revolving body, it communicates a distinct vibration, which is equal in its pulsations, so to speak, to the speed of the cylinder: the natural eccentric throw carries the supporting frame with it, as far as its weight will permit. We know that a heavy body moves slowly, so that in proportion to the weight of the supporting frame its journey must be long or short; so that, in order to overcome the imperfections in machinery, they have increased the weight in some cases; that is, they assume to cure the effect instead of the cause. This calls for another question: Will a revolving body, under all or any conditions, live as long revolving in a rigid supporting frame as it will in a flexible one?

Mr. LOCKWOOD. [Mr. CUMNOCK, Vice-President, in the chair.] Mr. Garsed when he was up stated that a one-story mill cost more for heating. It occurred to me as he made that

remark, whether it did not cost more to keep a one-story mill in repair than a two, three, or four story mill. Take a mill like the Androscoggin Mill at Lewiston, where Mr. Goulding is, or some others. That mill contains some fifty-odd thousand spindles. It is now one-tenth of a mile long. It has five floors: of course if the machinery were all on one floor, — a one-story mill, — it would have half a mile or more of roofing, instead of a tenth of a mile. Well, we all know that the cost of keeping the roof of a mill in repair is no very small item. Then there is the question of the first cost. I know there are some figures that have been given, going to show that a one-story mill can be built as cheaply as a two-story mill. I am about making a plan for a weaving-mill for sixteen hundred looms. It is a question with me, whether I will make one story or two stories, — whether I will have it four hundred and fifty feet long and one hundred feet wide, or whether I will have it nine hundred feet long. If it is true that you can build a one-story mill, including the foundation, the roof, and the shafting (of course in my case it would take twice as much shafting in one case as in the other), — if I could build a one-story mill, and build it as cheaply, including foundation, roof, lighting, shafting, grading, and every thing else, I can see some good reasons why I should do it. But I have not been able, from any reasoning of my own, to see my way clear to adopt that plan; and I would like to inquire a little further into Mr. Garsed's views, or Mr. Whiting's, or any other gentleman's, as to the cost of erecting such a building, including shafting. Of course none of us would have much apprehension of a two-story mill one hundred feet wide, as commonly built, vibrating, even though the looms were on two floors; I don't think we should have a great deal of apprehension on that score. I would like to get these gentlemen's opinions, whether with their experience and the thought that they have given to it they can make it clear to my mind, that, all things considered, it is a matter of economy to build a one-story rather than a two-story mill under those circumstances. I make this inquiry for two reasons. In the first place, I want light myself; if I am wrong in my own opinions, I want to be corrected. Besides, I want this thing discussed and considered more fully, before we adopt or reject any plan or form of construction.

Mr. GARSED. I am not desirous of occupying much of the

time of the meeting. With regard to a weaving-mill, if you are going to take that line, I should unhesitatingly say, build it one story high. If you put shafting in the weaving-room, two stories high, you necessarily are going to drive through the floor. We all know the objection to that, — the danger of fire. Now, upon the question of repairs: with the exception of the roof, we have not spent one penny on that mill since we built it. There is nothing upon the walls but roof and shafting. The roof we put on of gravel, expecting it to last, I think, about ten years. I think it has been renewed once thoroughly: so that you can easily draw your own conclusions about the economy of good roofing. The first girder is twelve feet from the stone floor. The pitch of the roof is five feet in thirty-three; so that we have an average height of some fourteen feet six inches. That is where comes in the difficulty, or the additional expense of heating; but we have the advantage of very much purer atmosphere. Now, of all machinery known, the loom is the most awkward machine to drive. You are nearly all experts here. If you will watch a loom, you will see that when the crank is at the top, you are going to throw the shuttle. The cams are pressing down the yarn at the same moment of time. When the shuttle has passed, you relieve the treadle of the cam, which throws the entire machine out of balance, and it seems to be irremediable. There is no way to balance the wheel twice upon its revolution. The straps and the cords would destroy that, even if you could do it. Consequently it is almost impossible to build a mill more than one story high for looms, that will not have a dangerous vibration, so far as the wear and tear of your machinery is concerned. Where I have observed mills running on very heavy goods, such as velveteens, &c., they have universally been on a stone floor; and one of the most successful manufacturers in England told me that he had three hundred looms on the ground floor, and was satisfied he never could have made the goods, had he not adopted that plan. In the drawing before us there are nine shafts to drive it. We reverse the ordinary run of spinning-frames here. Our plan is to drive a shaft down each side. We have but two shafts to drive thirteen thousand spindles in that room. There could be no less, probably. The only drawback is the twist on the pulley. We have found no difficulty yet. My impression is, that I would build a one-story mill again, changing only the

mode of making the floors. Another point: at the time we built the mill, insurance was an element. Two per cent was an important matter to consider I think we have insured the mill about one-eighth of its value. That in Mutual offices has cost a little less than one-third of one per cent. Had the mill been two stories high, we should have had to have insured the whole value of the mill, and at two per cent. That must also be put in favor of the one-story mill. But, with a weaving-mill, I should have no hesitancy whatever. I would no more think of building a weaving-mill more than one story high, than of walking from here to Philadelphia.

Mr. WHITING. I would like to answer Mr. Lockwood in the argument that he has made on the score of economy. In the first place, if you build a six-story mill, you have to go clear down to hard-pan for the foundation; which must be of heavy stone laid with a derrick. In the case of a one-story mill you would save the four inches by which the first story was thicker than the second. You would save something in the time of building the walls, because you have only got to go one stage, — the bricks can be tossed on the stage, avoiding the necessity of hodding bricks or mortar. Of course the extra roofing will take the place of the second floor. But, if you build a mill one hundred feet wide, it will cost more to light it if it is two stories high, than it will if it is one story high. That makes the difference in the Renfrew plan of a mill one hundred feet wide over one of sixty feet wide; and that makes more saving of gas than any thing else. It is one hundred and thirty-four feet wide by three hundred and thirty-three feet long. I cannot say how many spindles it has. It was built for a thousand looms.

Professor LANZA. Though I am not a member of the Association, I have been listening with a great deal of interest to the discussion, as I am very much interested in the question of vibration; and I regret that, in the turn that the discussion has taken, it seems to be tacitly accepted as a foregone conclusion that the only remedy for vibration is to build a one-story mill. That such a conclusion is entirely fallacious, is, I think, evident even from Mr. Woodbury's paper; for it is there stated, I believe, that he found some very lightly constructed mills, where no vibration took place, and these were not one-story mills. Since, then, it is a fact, that there are mills of more than one

story, which do not vibrate, it follows that, although the building of a one-story mill and placing the shafting in the cellar may be a sure remedy, it is not the only one; and I believe that further investigation will develop other remedies for vibration in mills.

A MEMBER. If you turn all the shafting perfectly true, I think you can build a mill ten stories high.

Professor LANZA. In those cases where the vibration in mills is due to improperly balanced machinery, the remedy is, of course, to put the machinery in order. The question then remains as to the cause of the vibration when the machinery is not improperly balanced. In regard to this, Mr. Woodbury has compared the case of the vibration of a mill with that of a plate set into vibration by drawing a fiddle-bow across the edge; and of course, if this comparison is a correct one, it is plain that the succession of shocks given by the machinery, if in harmony with each other, might increase this vibration until it became very considerable, as in several cases already cited in the discussion. The question would then reduce itself to that of how the machinery should be placed so that the vibration should be as small and do as little harm as possible; and I believe that sufficient investigation would teach us how to place the machinery so as to accomplish this result.

Mr. BIGGS. In connection with the subject of the vibration of a mill from unequal motion of the pulleys, my experience has been, that if iron pulleys are turned upon a mandril of the same size, and screwed up as they would be on the shaft, and the pulley turned inside and out, and then balanced on the mandril, there will be very little trouble about the pulleys ever shaking the mill. There is nothing in the line of mechanics that is absolutely perfect, but that can be made perfect enough for practical purposes. And it will require very little balancing, if the pulleys are turned accurately inside and out.

Mr. LOCKWOOD. Now, if he will place the pulleys, as has been suggested, and if he will do another thing (and I will show him a mill constructed in that way), — if he will have the mill constructed so that almost literally throughout the mill he shall have a bearing at every pulley, — his trouble is at once at an end.

Mr. GARSED. I did not intend, Mr. President, to say that it was not possible to do it. I said the mills as they were ordina-

rily constructed, and as we find many old mills, would not do it. But, if you want to know how the matter is remedied in a mechanical way, split the hub of the pulley fitted to the shaft, as Mr. Grayson does, drive in a little key, and force it apart, put it on the place on the shaft where you want it, and let it go. Provided the hole is perfectly true through it, there is no trouble. If the spindle of the lathe upon which that hole was bored is accurate, if you then split the hub, and force it apart, there will be no trouble. Another remedy for it is to split the hub, and put a ring on the outside, with set-screw, so that the hub itself is drawn on the side of the shaft. I do not say that New England mills are not now properly fitted up. I am only talking about mills that were built twenty years ago, when I was a boy. [Laughter.] The careless manner in which it was done in those days is a very different matter from the manner in which it is done to-day; and I am aware, Mr. Lockwood, that there are very often mills in New England of good workmanship, and that you can show me one. We must take them all as we find them. I spoke about the set-screw system because I think it is one of the things we had better forget as soon as possible.

Mr. LOCKWOOD. We are here discussing general principles; and we are assuming that we are going to build new mills rather than old ones. The principles we discuss here should be *general* principles, — what we can do if we are to build new mills. I will admit that there are a great many old mills where it is quite difficult to remedy all the troubles that grow out of this. But yet, in regard to shafting a mill so as to prevent any essential shaking from the shafting, there is no practical difficulty of accomplishing that, whether the shafting is on the first, second, or third floor. But the mill must be properly constructed, and the shafting must be properly constructed and put up, and the whole thing properly organized.

Mr. ATKINSON. I want to say one word upon this. I have wondered why more one-story mills were not built. But I am not a practical manufacturer, and I determined to bring the subject here in this way. There is one advantage in the one-story "H" plan or the Greek cross plan, and that is apportionment of the space to the several departments, without reference to any other. You have each department by itself in its own wing. If the end of each wing is movable, and you need

to enlarge any department, all you have to do is to take the end out, and build a new section into the place. Here is a plan for a mill of sixteen thousand spindles, — a fair-sized mill. Now, the question comes, whether it would cost any more or any less to move the stock horizontally, — following the machinery, — to move it across from the carding-room to the spinning-room in this way, or whether it costs most to hoist it up, and lower it down. I would not contest the matter at all with Mr. Lockwood as to its being better to have a one-story or a two-story mill. If we underwriters can bring you down to nothing over three stories, we shall remove one of your causes of danger.

Now, there is another point against the high mills. Is it not worth while to save the vital force of your operatives in going up stairs five or six stories every day? Is there not a good point there? And in regard to facility of enlargement: suppose mule-spinning dies, you are not bound by any construction; you have got your room; you can enlarge it or do any thing you have a mind to with it. There are certain great advantages of the one-story plan over any other; but whether they can be made to extend to any thing beyond the economy to the carding and spinning rooms, this discussion will bring out.

A MEMBER. Mr. Garsed was speaking about his looms being put upon stone, — whether the repairs would be greater or less upon looms placed upon stone, than those in ordinary mills?

Mr. GARSED. I found no difference in that respect.

The MEMBER. I thought, from the rigidity of the stone, more repairs would be required.

Mr. GARSED. We put a piece of leather under in one case, and a piece of sheet-lead in the other. Of late years we have not used stone. The one-story mill has another advantage: if it gets on fire, — like the mill in Fall River, — you don't burn your workpeople. Another thing is, that, if you will build mills five stories high, I trust you will build staircases sufficiently far from the mill; so that the people will get into the open air, and not be burned by the lower story getting on fire and making a chimney of the staircase. Suppose that mill represented in the drawing to be one entire building. Now put your staircase at this end, fifteen feet away, with platforms running on to it; and another at the other end, in the same

manner. Then it is no matter which room gets on fire; the people simply walk out. The lower room burning will not fill the staircase with smoke so that they cannot escape. As we increase the building of these mills so many stories high, the question is, whether coroner's juries will not some day try some of us for manslaughter.

Mr. LOCKWOOD. I do think that there has been, I had almost said, criminality on the part of very many engineers of mills, in building without regard to the means of escape for operatives. In many mills built quite recently there is a distance of a hundred to a hundred and fifty feet from the staircases, where there is no escape except by those staircases. Now, if you have a fire, suppose your cards and your fly-frames are just to the right or left of these, and the fire flashes across, and cuts off communication, you have no possible way of escape for the operatives unless you have ladders made of most ample dimensions. Now, I do say that in the construction of every mill there should be an outlet at the extreme ends of the mill. If there is an ell, put an outlet at the extreme end of that also; so that, if a fire occurs at any part of the mill, the operatives can go one way or the other, and have egress by a flight of stairs where they can go down without the liability of becoming excited, and not be subjected to the danger of going down ladders. This is a point that I wish to impress upon all persons interested in mills. We owe this much to the operatives. We have no right to put up a building, and invite people into it to work, without giving them a chance to escape beyond any possibility of being cut off in case there should be a fire in the mill. Now, in the more recent mills that I have built, I have put on the extreme ends the staircases, in the corners, built of brick, just as though they were outside. Instead of building a tower in front, I build a tower in the corner, of solid brick, so that it is as safe in regard to communicating with the different stories, as though it were on the outside. Then, where there is an ell, I put the staircase there also, so that the operatives are not forced to go down a ladder, or be caught under any circumstances. I have not only built *one* mill so, but several. I am now drawing plans for three mills, in each of which I adopt that plan. Of course you must vary according to your local conditions. But that one thing should always be kept in mind, as a matter of justice to those whom we employ in these mills.

Mr. ATKINSON. My attention has of necessity been called very much to this point; and I have liked better than any other mill I have ever seen, the arrangement of the Richard Borden Mill in Fall River, with the towers on each front corner, — as shown in the example on the wall before you. I instructed our own architect, who made that plan, to put the two towers at the front corners, instead of having a centre tower and a rear tower. It seems to me that if the building is built strong enough, so that it will not oscillate, that is a great deal the better way, in more respects than as regards safety. It seems to me that the towers do not then interfere with the light as much as if they are in the centre; and that there is no possibility in that way of construction of the operatives getting caught at the end of the building by the flame running across, and scaring them. Moreover, there is an escape from the rear of that building, — an outside stairway leading down to the roof of the one-story building. And I desire to call your attention to a device which our friend Mr. Goodwin originated. At Indian Orchard we were called upon by the health inspector to build another means of egress for the operatives. We thought we had them ample, but he called upon us to build another one; and it was apparently a matter that would cost a considerable sum of money, — seven or eight hundred dollars, and perhaps a thousand dollars. Mr. Goodwin devised an outside stairway made of gas-pipe, angle-iron and wooden treads. It cost two hundred and twenty dollars. It is the best fire-escape I have ever seen. I have a plan of that, and a drawing, to be heliotyped.

I omitted to state that the Griffiths paint is entirely innocuous, and has no poisonous quality. It is to be procured of Lyman Hatfield, in Federal Street.

Mr. GARSED. Would not the matter of publishing these plans in our semi-annual report be worthy of consideration? Mr. Atkinson says they are entirely at our service. If it will cost but a trifle, I think they ought to be brought to the attention of our manufacturers. It will make a very valuable book, not only in America but in Europe, if the expense is not too great. I move that the plans be embodied in our next monthly report.

Mr. ATKINSON. I would suggest that that be left to the Board of Government. I stated what I supposed would be the

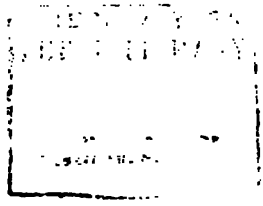
cost. As to sheets of this size, it may involve a pretty heavy expense. I would ask Mr. Garsed to accept that amendment, — that the matter be referred to the Board of Government.

The PRESIDENT. I would say that this going out in our book might give the impression that we indorsed it.

Mr. ATKINSON. I understand that the Association is never responsible for any thing that is said here.

The PRESIDENT. The motion is, that the plans be referred to the Board of Government, to decide whether they shall be published in our next report.

[The motion was adopted. The Association then adjourned.]



DEO GRATIAS.

THANKSGIVING DAY, NOVEMBER, 1879

It is difficult to give in words any more complete impression of the material strength of this nation than is conveyed by the graphical presentation of the areas of our States and Territories as compared to those of the most civilized and densely populated countries of Europe, when we consider the proportion of those areas to the area occupied by the principal crops on which our material welfare mainly depends.

Upon one fourteenth part of our whole soil, or upon one seventh part of that which is fit for agriculture, we produce the hay and roots that we require, and all the grains and cotton that we need ourselves, with as much more that, even if we did not produce an ounce of gold or silver within our borders, we could command the treasures of the world. Yet, if we consider the average product per acre in respect to every one of these crops, we find that it does not exceed one-half the quantity that even a reasonably good system of agriculture would bring forth. If we consider the conditions under which each and all of these great crops of grain, hay, and cotton are produced, we find that they represent in the lowest degree only the art of agriculture.

Not very many years since, the Genesee Valley and the central parts of the State of New York were mainly devoted to the production of wheat. From that point its cultivation gradually moved westward and northward, and now Minnesota and Kansas take the lead in this great crop. But this change does not mark the limit — rather the progress — of agriculture in the regions from which the culture of wheat has mainly passed.

In the great Mississippi Valley, wheat has found its natural home upon the Loess formation, the boundaries of which are not yet known. The soil of this same formation has been cropped with wheat for centuries in China, without exhaustion. The value of this soil is presented in the Hon. Alvesa S. Hewitt's speech, in which the resources of this country are so ably presented. The eastern boundary of this formation is somewhere in Ohio, the western extends to the great plains west of the Mississippi.

The farms of Central New York are better cultivated and more productive than when they were devoted to wheat. Even in the more sterile State of Massachusetts, the data of the last national census (which were quite inadequate in respect to the products of agriculture of that State) disclosed the fact that Worcester County stood only third among the county divisions of the whole country, in the value of the products of agriculture. The first was Lancaster County, Penn.; the second, the great dairy county of St. Lawrence, N.Y.; the fourth was Hartford County, Conn.; not until the fifth did we reach the corn land in La Salle County, Ill.; and, the wheat land in Oakland County, Mich.; and next we come back to Burlington County in New Jersey.

In 1870, the value of the products of agriculture of the five counties of Lancaster, Penn.; St. Lawrence, N.Y., Worcester, Mass.; Hartford, Conn.; and Burlington, N.J., all situated in the far East, was $39,804,340. Yet the area of improved land on which this value was produced was only 3,050 square miles, — an area that would be graphically represented on the scale of the county by this square: ■. The value of the farms of these five Eastern counties represented by this square was, in 1870, $342,766,811. The value of all the improved lands in the great corn State of Illinois was only five times as great; the value of all the farms in the great wheat State of Minnesota, a little more than one-half as much; and, in the great cotton State of Mississippi, less than one-half.

In this country, corn and wheat are not the pioneers of agriculture, and the cultivation of cotton is almost semi-barbarous, even under its present improved conditions of free labor; less than half a bale to an acre is the average, and that is the product of land under the richest uniloams and most unfit conditions of cultivation or of the poorest kind. One bale to an acre is the minimum of good cultivation.

The dairy products of the nation cannot readily be graphically presented by a line representing a specific area of land; but the value of the butter and cheese is nearly if not quite as great as that of the cotton crop; and, if the value of the milk consumed as food be added, the total value of the dairy product is more than that of the cotton crop, and as much as or more than that of the wheat crop.

Tobacco, sugar, and rice occupy so small a space, that the scale of the chart will hardly suffice to picture them.

The production of wool cannot be graphically defined; its final limit may be upon the cotton-field, where sheep, fed upon the cake that is left after the oil has been taken from the kernel of the seed, will fertilize the soil, double the crop of cotton, and add the wool-clip to the profit of the crop.

We number now nearly or quite fifty millions people; one hundred million could be sustained without increasing the area of a single farm, or adding one to their number, — by merely bringing our product up to our average standard of reasonably good agriculture, — and then there might remain for export twice the quantity we now send abroad to feed the hungry in foreign lands.

No longer divided by the curse of slavery, this nation is now united by bonds of mutual interest and of common speech, — tied by the iron hands of eighty thousand miles of railway, — and is yet only beginning to find the vital power and grandeur of a truly national existence.

On this day of Thanksgiving may we not gratefully contrast our position with that of other nations whose area is represented in the chart?

For the purpose of this consideration we will omit the semi-barbarous empire of Russia, with its vast area in Europe of 2,201,857 square miles, containing 76,291,447 people, and burthened by its almost unknown national debt.

We will omit the half-organized states of Roumania, 45,642 square miles, and 5,073,000 of people; Servia, 20,850 square miles, 1,710,522 people; Montenegro, 1,779 square miles, 195,500 people. We will omit the dying empire of Turkey in Europe, and the newly created states of Bulgaria, Eastern Roumelia, Bosnia, and Herzegovina, about 128,000 square miles and 6,313,000 people.

We will make our comparison only with the civilized countries of Europe. The various and states of Austria, Germany, France, Spain, Sweden, Norway, England, Scotland, Ireland, Italy, Portugal, Netherlands, Greece, Switzerland, Denmark, and Belgium, comprise 1,478,340 square miles, — an area about equal to the arable land of the United States; their population, according to the census of each country, taken at various dates in 1870 and subsequently, was 217,906,485. Their national debts amounted to $15,719,567,040 (nearly sixteen thousand millions of dollars), seven-eighths of which or more were incurred for wars in which the people had no voice, but which were entered upon to sustain the vested wrongs with which past generations of rulers have burthened the people of the present time.

These states and nations are guarded by armed corps containing standing armies to the number of 1,954,324 men, while a far greater number kept in reserve, and liable to be called to active war at a moment's notice, are wasting half their lives in military drill. In the forest nation of all, — Great Britain, — one-half the House of Lords and one-third of the House of Commons are said to be connected in some direct manner with the army, and are the men who mainly sustain the Tory administration in its policy of war, repine, and aggression.

It is but fourteen years since our national debt was over three thousand million dollars; its full amount never appeared by the books of the Treasury, because, before the amounts that were due and unpaid at the end of the war could be audited and settled, two hundred and fifty millions had been paid; since then it has been reduced seven hundred and fifty millions more, and we now owe but two thousand millions.

Our army is but a border police of twenty-five thousand men. Before the end of the century our debt may be all paid; and, if justice is done to the Indian tribes, we shall have less need of an army then than now.

Such is the picture that one may see between the lines of the chart, — in which chart there is but one area; the States in Europe should have been shaded in black, to symbolize the dark pall of standing armies and war debts that enshrouds them, while the States of this Union should be lined in pure white, brilliant with the promise of future welfare and prosperity. While we may well indulge in dreams of greatness, and in the glory of peace and plenty, we may well remember that the riches of a nation consist neither in abundance of money nor in abundance of land, but, — in the words spoken a century since by one of the great merchants of Philadelphia, Peletiah Webster, whose works are too little known, — "by its people in "good laws, good public officers, in virtuous citizens, in strength and concord, in wisdom, in justice, in wise councils, and in manly lives."

May we not well repair on our day of Thanksgiving the warning words of one now living, who himself has done as much as any other man to keep this nation true? —

> "For what avail the plough or sail,
> Or land, or life, if freedom fail?"

In the Providence of God there are no degrees of crime. The crime of slavery we have repented, and we have paid the debt of wrong by life and treasure. In our great duty we are still wanting; one national crime we still commit; one stain upon our honor still remains. The native who was to the manor born; whose trust we have abused; whose faith we have betrayed; the one alien to whom our courts of justice are utterly closed, — the Indian of North America pronounces our greatness to be a sham, our justice to be a mockery, our freedom to be a lie, and our boasted liberty to be a fraud. Until his wrongs are righted, on none in all this broad land can glad thanks for blessings now enjoyed, without humiliation because of evil tolerated and injustice unresisted.

EDWARD ATKINSON.

Boston, Nov. 27, 1879.

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APPENDIX.

THE COMMERCIAL WEALTH OF THE UNITED STATES: ITS NATURAL PRODUCTS AND MANUFACTURES, AS INVITING TRADE FROM FOREIGN NATIONS.

WE, as a nation, want access to the markets of the world, and not merely the chance to sell by seeking a market; but we need to make such an exhibit of our ability to rival other producers in offering the most desirable commodities, that foreign nations shall look to the United States as the best place for purchasing those natural productions and manufactures in which we abound.

The sharp apprehension of this need of a foreign market has been forced upon every thinking business man by the observation and experience of the past six years. The long depression in business has stimulated thought as to the causes of this depression, and the means of restoring business to its former activity, and keeping it in a stable and healthy condition as the country advances in population and power to produce. Different opinions prevail as to the efficient causes of our financial disasters, and many theories have been broached by practical business men and legislators as to the best means for restoring the country to sound business prosperity. But while these opinions have been so varied, and many of them antagonistic to each other, on one point all sensible men agree; and that is, that one great element in securing permanent success will be our ability to compete with other nations in the markets of the world with all our leading raw materials and manufactured products. To this all agree. They differ only in the means of reaching this result. The free-trader holds the doctrine of free trade, because he sees in it the direct method of reaching this result now; the protectionist holds his view, because he judges protection to be the best preparation for reaching the same re-

sult in the end. All look to the securing of a foreign market as a desirable result, because they see it to be an absolute necessity for permanent prosperity of such a nation as we are,—a nation abounding in all the raw materials that enter into the leading products demanded by the growing civilization of the world; a nation having the best food-producing territory on the globe; and a nation that, in consequence of its free government and wide-spread educational advantages, is noted for its inventions in labor-saving machinery in all the lines of useful production. A nation so situated and so constituted must produce vastly more in certain lines of industry than the home market can readily absorb. The producing power of wheat-fields, coal-fields, iron-beds, and waterfalls will be pushed to its greatest efficiency by such a people, so that a surplus will glut the market, depress prices, and paralyze business, unless there is a market among those foreign nations that are wanting the products in which we abound.

The case needs only to be stated, to make it apparent that foreign markets are a necessity for our progress in the very lines in which our activity has been for years moving; and that a nation so vast as ours in its resources not only must reach the markets of the world, but that it can do this successfully as a fair and generous competitor with the nations abounding in productions similar to our own. England has to-day one great advantage in that she is so well known. The nations have been accustomed to buy of her. This force of habit, this power of tradition, is strong in directing the currents of trade. The history of the past few years has shown, that, when our manufactures have become known, we have been able to compete with England even in her own markets. One of the great wants of our trade to-day is, that the nations of the world should know just what we can produce, and the prospect there is that we shall continue to produce these things in better quality and more cheaply than other nations. We need to let the merchants of the world know just what they can buy of us to the best advantage. The world-fairs have done much to aid us in this direction, but they have shown only the quality of the manufacture. They could give no adequate representation of the extent of our resources, and the combination of causes that will enable us to cheapen many staple products as no other nation can.

This is a subject that interests every producer, every business

man, artisan, and corporation. It is the small surplus in any product, that depresses the value of the whole below the cost of production, thus wiping out the profit on the whole, and destroying all reliability in business.

So mills go on half-time to diminish product. Half a product will yield a profit, while the whole product, by overstocking the market, would be sold at a loss.

When the markets of the world can be commanded, there can be no sudden piling up, because the area of distribution is too broad to be suddenly overstocked. Business becomes more steady with surer profits.

A man engaged in a business, the products of which are used only at home, is as much interested in the question of foreign markets as the one who trades directly abroad. The labor, or producing power, of a country, is wonderfully connected. It is like water in a great reservoir. Water drawn from any point affects the level of the whole. All labor, in a country, that finds a market in foreign lands, removes so much competition from those whose products are consumed at home. When foreign markets are shut off, all home markets have sharp competition from increase of laborers on the home-consumed products. Every yard of textile fabric sent out of the country gives a better market and better price for every yard sold in the country. Labor by the influence of the wide market is more certain of employment, and is better paid: so it matters little, considering the interests of the country as a whole, what specific article is sent abroad; it represents so much material removed from competition with products that are sold at home.

By the stimulus of foreign markets, also, labor is turned into the best channels, — into the channels where we can produce most at least cost.

It is good for a nation to have varied products; but the products and wants of the world are more varied than those of any one nation, and, when the world is the market-place, the call will be for those things in which we naturally excel, — things that we can produce at least cost. The producing of these is the most natural and most safe line for our industry. Thus the stability of business, and fair profits, are rendered more certain by securing foreign markets for any class of our products.

Influenced by these considerations, a wealthy association not identified with any special manufacturing or trade interest, but

impartially representing the whole country, have taken effective measures to make known to the world the advantages of American trade, the extent and richness of our markets.

They propose to carry out the work already begun, in part, by international exhibitions and in the scattered reports of our State and National Governments. It cannot be expected that these reports in all their details will be so understood by foreign nations as to sensibly influence trade. The materials which they present need to be digested; and the results, so far as they show an ability to meet the markets of the world, need to be so presented, and the works containing them to be so distributed, that every commercial centre of the world shall have easy and reliable means of knowing what we can do in supplying their wants.

The Association propose to publish a book on "The Wealth of the United States," setting forth especially our resources as a nation in raw materials and manufactured products. The book will probably contain about a thousand pages, with steel plates and woodcuts illustrating the extent and variety of our manufactures. Probably two years will be required for securing from the States and the United-States census reports the data required for making the work a standard authority for the next ten years.

It is intended to have all the great interests of every section of the country fully represented by writers best conversant with them. The whole work will be under the direction of myself as editor in chief, who will be held responsible for accuracy of statement, and that nothing shall appear in it, in the interest of any firm or corporation, in distinction from the great interests with which they are connected. No pecuniary aid is asked from any one in publishing the book; no direct profit is sought for in its publication. The Association look solely for their reward in the indirect benefits which they confidently expect to flow from their undertaking. The aim is, to have the work *national*, unbiassed by any individual or local interest.

The book will be printed in four editions, — English, French, German, and Spanish, — the latter especially for use in Mexico and Central and South America, — and perhaps in Russian and other languages. To secure the best possible distribution of the work, our Government, through the State Department at Washington, has agreed to instruct our consuls to collect infor-

mation in regard to commercial libraries and boards of trade in foreign countries, that the book may be placed in those where it will be accessible to the largest number of business men. A thousand volumes in each language will be presented to the libraries and institutions thus selected, through the agency of our consuls or the Smithsonian Institution. The cost of the work will not be less than fifty thousand dollars, which will be paid entirely by the Association in charge, so that no pecuniary obligation will be incurred upon which any special demand might be founded in favor of private interests. As the book will thus interest every man and business association, it is hoped that a certain kind of aid in the preparation of the work will be readily and cheerfully granted.

The request is hereby made of each board of trade in the commercial centres in our country, that they shall, in their *official capacity*, cause to be prepared for the use of the editor a statement of the business transacted by them, its nature and extent, — in fact, giving all the data and information which they wish to go forth to the world as influencing buyers in their market. In this way the editor will have the information that he needs for the work, and each section and interest will be duly represented.

When the editor is notified of the names of the persons or committees appointed by the official action of any association, or in the interest of any city or section of the country, blanks will be provided, so that the information may be definite and in as concise a form as is consistent with accuracy. The prompt action of all boards of trade and associations, by whom this article is read, is respectfully solicited.

P. A. CHADBOURNE.

WILLIAMS COLLEGE, WILLIAMSTOWN, MASS.,
Nov. 10, 1879.

[The following article on Cotton and Cotton-manufacture in the United States has been prepared for the work described in the preceding pages. — E. A.]

COTTON AND COTTON-MANUFACTURE IN THE UNITED STATES.

BY EDWARD ATKINSON, ESQ.

The cotton plant belongs to a family of which the HIBISCUS and MALLOW are well-known species, growing in the northern part of the United States and elsewhere. It is botanically known as *Gossypium*, under which name are classified several species and many varieties, both annual and perennial. It is indigenous to many parts of the world, both tropical and temperate; but the most useful sorts are those which grow in the southern part of the Temperate Zone. A tree cotton is found in the tropics, producing a fibre very silky and beautiful in appearance, but useless for want of the form and structure in the fibre which make it possible to spin the cotton of commerce.

A vine cotton is known in some of the West India Islands. In China and Japan may be found varieties producing a short, clean, and very white staple; in India many varieties commonly known as "Surats" (a name commonly applied to all East Indian cotton, but which really belongs to a single district) — also short in fibre, with the exception of one kind of long and fine staple produced in Dacca by a small class of people, with whom the cultivation is an hereditary employment, and from which the fine muslin known as the "woven wind" is manufactured. In Africa are to be found several varieties; but the only kind known to commerce is the valuable cotton of Egypt, next in quality to our "Sea Island" staple. Aside from this the cotton of Africa has a short and woolly staple. A small parcel imported by the writer from Lagos, during the late civil war, was worked into fabrics closely resembling a woollen flannel.

In Brazil a considerable quantity of useful cotton is now produced, and upon the Paraguay and Parana Rivers are vast tracts of land capable of producing the best varieties; but as yet these places are lacking in good governments, and the security to property which can alone assure adequate labor and good cultivation. The same may be said of Mexico. Cotton

has also been raised in Asia Minor, Turkey, Italy, and in the islands of the Pacific. In fact, the area of land adapted in some degree to its growth is practically unlimited; but the area that produces the most useful variety is practically limited to the Southern United States, the South American and Mexican soils being excluded from successful competition with them from want of stable governments.

The actual annual cotton crop of the world cannot be ascertained with precision, but an approximate estimate can be made. The commercial crop, or what may be called the portion which is worked by complex machinery contained in the factories of Europe and America, is accurately known. The most complete estimate is contained in the annual statement of Thomas Ellison of Liverpool, from whose last report the following data are taken: —

CONSUMPTION OF COTTON IN THE WORLD.

"In the following statement we give an approximate account of the quantity of cotton consumed in each country in Europe, and the various groups of countries in Asia, Africa, America, and Australia. The population figures represent thousands (86,260 = 86,260,000); the quantities of cotton and cotton goods represent millions of pounds (142.5 = 142,500,000 lbs.). There are three columns of quantities: First, the raw cotton spun in each country; second, the *weight* of goods and yarns imported into each country from Great Britain; and, third, the total of these two. The table also shows the *per capita* consumption in each country of raw cotton, of goods, &c., imported from England, and the aggregate of both. The population of Russia includes that of Asiatic Russia. The whole of the figures refer to the year 1877 — the complete returns for 1878 not being yet published. In the column of "Goods, &c., imported from Great Britain," there is a blank opposite Switzerland, because the shipments are sent *via* other countries. A large part of the Swiss production goes to Turkey and to various continental countries. Part of the production of Holland goes to Java, and part passes to Germany, Switzerland, &c. Belgium also forwards largely to the interior of the Continent. The exceptionally large consumption of cotton in the United States is owing to the smaller *per capita* consumption of wool and flax compared with Europe. Moreover, the figures include goods imported.

Countries.	Population.	Raw Cotton Consumed.		Goods imported from Great Britain.		Total Consumption.	
		Pounds.	Per Head.	Pounds.	Per Head.	Pounds.	Per Head.
Russia	86,260	142.5	1.65	2.6	0.03	145.1	1.68
Sweden and Norway	6,291	24.8	3.94	8.0	1.27	32.8	5.21
Denmark	2,023	–	–	5.0	2.47	5.0	2.47
Germany	42,727	249.1	5.83	65.2	1.52	314.3	7.35
Austria	37,331	101.3	2.71	7.9	0.21	109.2	2.92
Holland	4,130	13.8	3.34	43.0	10.41	56.8	13.75
Belgium	5,336	43.2	8.09	17.4	3.26	60.6	11.35
Switzerland	2,776	42.5	15.30	–	–	42.5	15.30
France	36,906	230.0	6.23	19.9	0.54	249.9	6.77
Spain and Portugal	21,275	79.9	3.75	25.7	1.21	105.6	4.96
Italy and Malta	26,948	52.8	1.96	51.1	1.89	103.9	3.85
Greece	1,450	–	–	6.9	4.75	6.9	4.75
Turkey, Roumania, &c.	15,353	–	–	37.0	2.40	37.0	2.40
	288,806	979.9	3.39	289.7	0.99	1,269.6	4.38
Russia	86,260	142.5	1.65	2.6	0.03	145.1	1.68
Rest of Continent	202,546	837.4	4.11	287.1	1.41	1,124.5	5.52
Great Britain	34,160	195.7	5.72	–	–	195.7	5.72
Total Europe	322,986	1,175.6	3.63	289.7	0.89	1,465.3	4.52
Turkey, Persia, &c.	24,540	–	–	38.0	1.54	38.0	1.54
India	250,000	295.0	1.18	330.0	1.32	625.0	2.50
China	435,000	1,000.0	2.29	100.0	0.23	1,100.0	2.52
Japan	33,620	65.0	1.98	20.0	0.59	85.0	2.52
Siam, Java, &c.	12,500	–	–	30.0	2.40	30.0	2.40
Total Asia	755,660	1,360.0	1.79	518.0	0.69	1,878.0	2.48
Egypt and North Africa	17,000	–	–	34.0	2.00	34.0	2.00
West, South, and East Africa	13,000	–	–	28.0	2.15	28.0	2.15
Interior of Africa	200,000	–	–	–	–	–	–
Total Africa	230,000	–	–	62.0	0.26	62.0	0.26
United States and Canada	48,850	628.0	12.85	22.0	0.45	650.0	13.30
Central and South America, and West India	43,250	–	–	135.0	3.12	135.0	3.12
Total America	92,100	628.0	6.82	157.0	1.70	785.0	8.52
Australia	2,650	–	–	15.0	5.66	15.0	5.66
The World	1,403,396	3,163.6	2.26	1,041.7	0.74	4,205.3	2.98

"Official reports show that the consumption of cotton goods in India is about two and one-half pounds per head per annum. We have assumed that a similar rate of consumption obtains in China and Japan. Russia imports some cotton from her Asiatic possessions. The quantity varies considerably. In 1861 it was only 150,000 poods of thirty-six pounds each; during the American war it rose to 750,000 poods; since then it has fallen off. Some cotton is grown and manufactured in the interior of Africa, but it is impossible to say how much. We cannot take the population as a basis, as estimates of *that* range from 150,000,000 to 400,000,000. We have adopted 200,000,000 in addition to the estimate of the number of inhabitants on what may be termed the margin of the Continent. Some native cotton is also consumed in Turkey and in the various countries of South America. The entire production of cotton in the world may be estimated as follows:—

	Pounds.
Imported into and consumed in Europe	2,217,000,000
Consumed in the United States	628,000,000
Native consumption in India, China, &c.	1,360,000,000
Total as above	4,205,000,000
Native consumption in Turkey	20,000,000
Native consumption in Africa, one pound per head	200,000,000
Native consumption in South America, &c.	40,000,000
Received by Persia from Bokhara, &c.	15,000,000
Total crop of the world	4,480,000,000
Equal to bales of 400 pounds	11,200,000

of which about one-half is grown in the United States. One-half of the whole is also spun in Europe."

The writer would not fully accept Mr. Ellison's estimate, especially in reference to China, a country of which a large and densely populated portion is in a temperate zone where the winters are severe. Hence the estimate of only two and one-half pounds per head would be quite insufficient, as this is the average consumption of India, where a breech-cloth constitutes the entire dress of by far the largest part of the population. Gentlemen who have long dwelt in China — one holding high official position — concur in the writer's estimate of five pounds per head.

In considering this estimate, it must be remembered that cotton constitutes the chief material for clothing the inhabitants of China, India, and Central Asia, and also of Africa, and that as yet but a very small proportion of the inhabitants of these countries are clothed in fabrics made upon the machinery of either Europe or the United States. If we consider China separately, we can make an estimate of the possible future demand for fabrics made by machinery. The Chinese are a well-clothed people, and the substance of their clothing is mainly cotton; only the rich using silk or other fibres. The population of China is commonly estimated at from three to five hundred million; the latest Russian computation, which is probably based on the best information, reaching the latter number. Assuming that not less than twenty yards of what is known in England as a "China shirting," the fabric most largely exported from England to China, or sixteen yards of "China drill," such as we send in largest quantity, are required for the annual supply of a Chinaman, or about five pounds to each person, and using this unit as a divisor for the

annual export of cotton fabrics from England and the United States to China, combined, we find that if the goods were all used as the material for dress, it would not suffice for over thirty millions. But in fact English and American goods serve to clothe a much less number, as the largest portion of our heavy fabrics are used for the boat sails and awnings of the immense river population of the country. The rest of the people are clothed in hand-spun and hand-woven fabrics made from their own inferior, short-staple cotton.

Commerce has, as yet, reached but a fringe of China, and what may yet be its extension is an unsolved problem. In India, again, and in other parts of Asia, by far the largest portion of the population is clothed in hand-made fabrics; and the same is true of the unnumbered hordes of Africa.

It therefore seems probable that the unknown crop of cotton of the world is equal to the known, or commercial, crop. If the Chinese be estimated at 400,000,000 only, consuming five pounds each, or less than one-half the annual average consumption of the people of the United States, we find a requirement for 2,000,000,000 pounds of cloth, the product of 2,400,000,000 pounds of cotton, or 5,000,000 bales of 480 pounds each, — a quantity equal to the present annual crop of the United States.

What, then, is the chance of demand upon us that is implied by this statement? It may, perhaps, be said that the Chinese themselves will enter upon the construction of cotton factories, as has already happened in India; but in reply to this, let it be considered, —

First, That already the East Indian mills are importing American and Egyptian cottons, because of their superior quality, and because the additional quantity of cloth that can be produced in the factory where they are used compensates for the difference in price as compared to "Surats," and that the cotton of China is not even as well adapted to machinery as that of India, called "Surats."

Second, That the cost of manufacturing a yard of China drill in this country, or a yard of China shirting in England, aside from the material used, is less than a cent and a quarter, including the pay of every one employed, from the agent who controls the mill to the scrub who washes the floor.

Third, That in one of the largest mills in this country, now making drills for export, the average annual product of each

operative is 8,000 pounds, or enough to clothe 1,600 Chinese at five pounds each.

Fourth, That the proximity of the mills of New England to the cotton fields of the South gives them an average advantage of not less than one-half a cent, oftener three-fourths of a cent, a pound in the cost of cotton, as compared to their competitors in Lancashire, which advantage may enable their managers to pay at least twenty per cent higher wages, and yet produce a given kind of cloth at an equal cost.

Fifth, That the improvements and inventions which have been introduced into a given mill, which is a fair example of all, since 1860, have compassed the following results: —

1. A decrease in the proportion of the operatives to each thousand spindles (including with spindles the requisite proportion of preparation and of looms to make and finish the cloth ready for market), of from twenty-six and one-half to fifteen; or forty-three per cent.

2. A decrease in the cost of labor, per pound or yard of cloth, of twenty-one per cent.

3. An increase in women's earnings (women or girls constituting about three-fourths of the whole force), of thirty-three per cent.

At the same time, the improvements and inventions that have been applied in other branches of production have decreased the cost of all articles of comfort or necessity used by the operatives, so that each gold dollar of to-day will buy more of the necessities of life than the gold dollar of 1860.

If, then, the commercial crop of the world is now equal to a little more than 6,000,000 bales of American weight, of 480 pounds each, and the demand of nations that still use hand-made fabrics requires nearly or quite as much more, we have a total supply of 11,000,000 to 12,000,000 bales in all, or more than twice the quantity now raised in this country.

Upon what grounds can we assume that we shall year by year absorb an ever-increasing proportion of this staple production? and what are the conditions that have given us already such a paramount position in the matter?

The answer to this question needs only a consideration of the kinds of cotton we produce, the method of their production, the nature of our soil, and the adaptation of our climate to the growth of cotton.

Taking up these subjects in their order, we observe that there are but two general varieties of useful cotton.

First, the black or smooth seed cotton, in which class are included the Sea Island, Egyptian, and Brazilian staples. The Sea Island cotton, grown upon the islands of South Carolina, in Florida, and on the coast of Texas, is the finest variety known; it thrives in the sandy soil of the regions named, which sand is largely composed of minute shells or fragments of them. It needs salt in the soil and in the atmosphere, and the staple deteriorates if its cultivation is attempted inland. It is used for the manufacture of sewing-thread, and for the finest muslins and laces of Europe, but it is not an important factor in the cotton question.

Egyptian cotton is coarser and not so long, and with the South American cotton from Brazil is much used in England, France, and Switzerland, for the manufacture of the finer fabrics that are there woven. It has sometimes been assumed that Egypt might become a strong competitor with us in the production of cotton for the common uses that constitute the greater part of the manufacture; but it became evident, during our civil war, that the high price of cotton diverted too much of the labor of the people from the necessary work of raising food, and, although Egypt furnishes a considerable quantity of useful cotton, it is now very evident that no great increase can be expected from her soil.

We now come to the *green* or *woolly* seed cotton, which constitutes the greater part of the world's production, and which also constitutes the commercial crop of the United States. Of this variety must the twelve million bales needed in the world for its cheapest, most wholesome, and most useful material for clothing, mainly consist; and we now produce annually over five million bales, or nearly one-half of this whole quantity. The area required, at the present time, for this production, is about twelve million acres; but under the better methods, and with the use of fertilizers now prevailing, the average crop per acre is annually increasing.

Let it be considered, however, that this area is less than nineteen thousand square miles, and that the area of the ten cotton States is over six hundred and fifty thousand square miles, the State of Texas itself exceeding the area of the present Empire of Germany by about sixty thousand square miles.

Hence it appears that even if we were called upon to make the whole twelve million bales needed by the world, we could find good land equal to the entire need in Texas alone, or it could be divided between any two of the other cotton States, or all placed within the limits of the Indian Territory that is not yet open to settlement, and is not counted as a cotton country, without trenching in any degree upon land needed for other use.

The maintenance and increase of our crop is, therefore, a simple question of adequate labor, and not of land. What, then, is the labor to be thereto applied? In Texas, which now produces nearly one million bales, or twice and a half the largest crop ever raised within her limits in the days of slavery before the civil war, cotton is the product of white farmers; such is also the labor mainly applied in Northern Georgia, in many parts of Tennessee, and in North Carolina; but this is not our main dependence. It may now be affirmed that there is nowhere in the world a force of laborers that can be so easily controlled, so effectively worked, or so cheaply sustained, as the free colored laborers of the cotton States, when they are rightly and honestly treated. This allegation will doubtless be contested by many persons, but will not be questioned, but, on the contrary, will be fully sustained, by such Southern gentlemen as have learned to apply capital, intelligence, tact, and fair dealing, to the cultivation of cotton, sugar, and rice in the Southern States.

In respect to food, where else can there be found a force of laborers, the material for whose subsistence can be furnished for six cents or threepence a day, — giving them the food they like best, that on which they thrive most, and from which they can develop the most force? yet such has been the measure of the cost of the three and one-half pounds of bacon and the peck of meal, which, with one quart of molasses or syrup, constitutes the chosen and adequate weekly ration of an adult laborer in the cotton field; fish, game, and their own gardens furnishing them with their simple luxuries. It may be true that the Chinese and East Indians can be subsisted at less cost in money; but, if regard be given to the amount of force in the food, rice must yield to bacon and corn.

The dwelling, which to the freedman may be a palace compared to the quarters which he used to occupy, costs but little

money, and the climate calls for moderate expenditure for necessary clothing.

It is believed by those most competent to observe, that the colored population of the South is now rapidly increasing, after having been somewhat checked in its increase immediately after emancipation.

If we, then, possess a vast excess of good land, and a rapidly increasing force of effective laborers, it needs only to consider the climatic and geological conditions which have so rapidly restored our supremacy in the supply of cotton since the civil war.

The great Appalachian chain of mountains, extending from the north-east to the south-west, marks a line on which the moisture brought in from the great Gulf Stream of the Atlantic is condensed, — falling in showers over the Carolinas, Georgia, and Alabama, on whose uplands healthy homes for white cotton-farmers may be established almost without limit. To the west of this chain, the great valley of the Mississippi and its tributaries, bordered by bottom-lands of untold fertility, offer the boon of great crops to compensate for the less healthy condition of climate; yet on these rich river-bottoms, colored laborers who are free from danger of malaria may bring forth wealth in cotton, sugar, and rice.

In Texas the melting snows of the far-distant Rocky Mountains, flowing under the arid regions of the north-western part of the State, burst forth from the ground as rivers fully grown, lending moisture to the soil over vast areas even before the great springs appear that are the beginning of these rivers.

Throughout this vast area, the soil is filled with the shells of minute infusoria, that serve in part as the source of the inorganic material which is needed in very great quantity to produce the seed of the cotton plant.

Over all this area is found a climate that is not tropical; and in the largest part of it white men can live and work in comfort. The mean summer temperature of the upland cotton country is, in such places as Augusta, Ga., not as high as that of the lower portions of Philadelphia, in Pennsylvania, one of the largest cities of the North; while the extremes of heat in St. Louis, Mo., are greater than in New Orleans, La., yet nearly half the people of St. Louis are Germans.

To the Italians, the French, the Spanish, and the inhabitants

of South Germany, accustomed to the climate of warm countries, the Southern States offer homes and work that will assure a comfortable subsistence, with far more than the average opportunity to create wealth; and in almost every part the crop of cotton that may be raised may become a sure money crop, for which a market is always certain.

Since the removal of slavery, a great change has taken effect in the method of cultivation of cotton; the system of great plantations has nearly ended, and the farm system has taken its place; better tools and implements are being used, and such a field for invention and for new appliances is opening, as does not exist elsewhere in this country.

The effect of all these changes has been a rapid increase in the quantity of cotton produced since the civil war as compared to the years immediately preceding. The last ten cotton years, each ending Sept. 1, have yielded 6,459,303 bales more than the ten years preceding the war, as will appear from the table given below: —

CROPS OF		CROPS OF	
1870	3,154,946	1852	3,090,029
1871	4,352,317	1853	3,352,882
1872	2,974,351	1854	3,035,027
1873	3,930,508	1855	2,932,339
1874	4,170,388	1856	3,645,345
1875	3,832,991	1857	3,056,519
1876	4,669,288	1858	3,238,962
1877	4,485,423	1859	3,994,481
1878	4,811,000	1860	4,823,770
1879	5,073,531	1861	3,826,086
	41,454,743		34,995,440

This gain is largely, if not wholly, due to better cultivation, better tools, and to the vast increase in the use of fertilizers, giving larger products from smaller area.

It will be observed that the last five crops exceed the five crops immediately preceding the war, by nearly 4,000,000 bales; a gain of free labor of not less than $200,000,000. The value of the ten last crops of cotton has been between $2,500,000,000 and $3,000,000,000 in gold.

If we consider what cotton is, and how it grows, we may get

a glimpse of the opportunity for improvement, invention, and discovery.

The fibre is the wing of the seed. In its immature state, it is a hollow cylinder filled with watery sap: when mature, the sap dries away, the cylinder collapses lengthwise, bursts the boll, and extends in length in a spiral form like a twisted ribbon, a little thicker at the edges than in the centre; it is attached to the seed at the base, and pointed at the end. It is this spiral form that causes the fibres to adhere to each other, and which makes it possible to spin it.

The production of fibre by the cotton plant, although most useful to mankind, is but a secondary function. The fibre is nearly pure carbon, hydrogen, and oxygen derived from the atmosphere; there is but little more than one pound in a hundred of inorganic material derived from the soil. The production of seed is the chief process which exhausts the soil; but when this seed is converted to such useful purposes that its inorganic material can be returned to the soil, the crop of cotton may be doubled, and yet the land grow richer instead of poorer. There are two to two and one-half pounds of seed to each pound of cotton; and four per cent of the weight of the seed is mineral element drawn from the soil, mostly phosphate of lime and potash.

The following analysis will give the relative quantities: —

ASH OF COTTON SEED.

Potash	36
Phosphoric acid	36.2
Magnesia	14.2
Lime	6.2
Sulphuric acid	4.1
Soda	1.1
Oxide of iron	.6
Chlorine	.5
Silica	Trace
Loss	1.1
	100

This analysis is one of many that have been made, and substantially agrees with others. Slight variations will occur, according to seasons and soils.

For every hundred pounds of cotton fibre there are taken from the soil, in the seed, eight to ten pounds of precious min-

eral substances, all of which may be profitably saved. This process of saving is now beginning. In the old days of slavery this element of wealth was mostly wasted, and as yet it is too rudely treated to yield its full return.

Our present average crop of cotton fibre may be estimated at 5,000,000 bales of 480 pounds each, equal to 1,200,000 tons of 2,000 pounds each. At the rate of two and one-half pounds of dry seed to each pound of cotton, the seed crop is 3,000,000 tons, of which about 120,000 tons consist of mineral elements, as stated in the foregoing analysis.

The seed consists of about one-half kernel and one-half hull. They are easily separated, and the kernel is now largely used for oil, yielding about twelve and one-half per cent of its weight in oil of great value for many purposes. The oil cake is mostly exported to Europe, where it is used for feed, for which it is greatly valued, because the manure from cattle fed with it is richer in fertilizing property than that produced from any other known food.

The hulls have been mostly burned or wasted, but it is now evident that they must be all used. In New Orleans they were last year (1878) either thrown into the river by shiploads, or burned, and the ashes mostly wasted; but it was observed that if cattle had access to a pile of hulls they devoured them eagerly; and now all the hulls that are to be had are in demand, at ten to twelve dollars per ton, for feed. This was evidently a true perception on the part of the cattle, because almost the whole of the mineral element is in the hull, and not in the kernel. It is therefore evident that the true use of the hulls is to grind them into meal with the oil cake, unless they prove to be too valuable for paper stock than to be used for feed. When bleached and pulped, they make a very strong material for paper.

That there is a great field for invention and discovery in the use of cotton seed in the arts, is very obvious; but it is very bad economy to remove that which constitutes the portion suitable for feed from the soil.

A very large portion of Northern and Western Georgia, South Carolina, Alabama, and Mississippi, has a light sandy soil of great fertility under proper treatment. In the neighborhood of Augusta, Ga., old fields, that have been so exhausted by unskilful cultivation in the old slave period as to produce only

one hundred and fifty pounds of cotton lint per acre, have been brought up to a product of over six hundred pounds of lint by the use of pine-leaves from the adjacent woods, and stable-manure.

There are within the limits of these States more square miles of light, sandy land, covered with pine-trees, than would be needed to produce the whole cotton crop of the world. This land is of easy cultivation, and peculiarly adapted to sheep-growing. It suffices only to girdle the pine-trees, and the timber will stand for fifty years in sound condition for use. When the tops die off, grasses come in that yield good sustenance to the sheep. But, under a proper method of treatment, these lands can be made more certain of yielding a bale of cotton to the acre than even the richest river-bottoms; because they are less liable to overflow and to insects. They may be more exposed to drought; but it must be remembered that cotton is a sun plant, sending its tap-root deep into the soil, and that dry years yield the largest crop of fibre.

If, then, these lands which are free from malaria, not exposed to any degree of heat that renders them unfit for cultivation by white farmers, and are admirably adapted to the production of both wool and cotton, what more suitable method can be devised than to combine the two?

It would seem to the observer that the right method would be to enclose the fields with the barbed wire fence that costs but a trifle, running the wire from tree to tree; and to alternate sheep and cotton, feeding the sheep on the ground meal and hulls of the cotton. Thus the cotton crop might be doubled, the wool clip added, the oil saved, and the land made richer year by year.

If a rotation of green crop is needed to interpose between the two, the use of the vetch, or cow-pea, may be considered for the third year.[1]

At present it is alleged that sheep cannot be successfully kept in this region, owing to the pilfering of the negroes and the destruction of dogs; but it has been found, that if certain negro families have an interest in the pigs, chickens, and sheep

[1] The vetch, or cow-pea, is a plant of exceedingly rapid growth on sandy land, covering the ground with a heavy crop, sending its roots deep into the soil. It may be turned under, or allowed to decompose upon the surface; in either case serving its purpose as a fertilizer.

of the farm, stealing ceases. It has also been found, in California, that dogs prefer dead meats to live mutton, and will choose the pieces set up for them in the corners of the sheep-range; and that, if a little strychnine is added, it indisposes them for other meals.

Finally, it may be added, in respect to this branch of the subject, that although, under the slave system, there existed a class of planters of great intelligence who made the most effective use of the land that the system would permit, it was in its nature a wasteful system, and that at the present time the application of methods of saving has just begun.

There is a vast field for invention in the matter of new gins, — the saw-gin being in its nature unfit for its purpose: its only merit being the quantity of lint that it detaches from the seed. A beginning has been made in the invention of machinery for cleaning cotton more perfectly before it is ginned. New and better presses are also called for, for farm use.

In short, it may be said, in respect to the cotton of the United States, that half the world or more remains to be conquered; and yet half the work or more remains to be done in the utilization of seed, motes, and other waste, in the invention of the machines that ought to precede the work of the cotton factory, and in the application of new methods of cultivation.

It is to this work in our Southern land that the poor of other nations may betake themselves with every assurance of commanding comfort and welfare as time goes on.

The conclusion of the whole matter, in respect to the production of cotton in the United States, is this: Disregarding the bottom-lands, on which the heaviest crops of cotton are now made, there is a wholesome, salubrious upland country, of which the larger portion could now be bought, in an unimproved condition, at fifty cents to a dollar an acre, more than adequate to the production of the crop of the world; a region where white farmers can and do work in health and comfort, and where negro laborers can be hired.

In this section, the meat and corn most desired by the negro, and the necessary supply of clothing for an adult, can be bought for one dollar a week.

It is not intended to say that laborers are or ought to be satisfied with such a modicum of food and clothing, but simply to state that such a supply would, in connection with

the products of their gardens, be sufficient for health and strength.[1]

Having thus endeavored to state the present condition and future prospect of the cotton production of the United States, let us now turn our attention to the second division of our subject.

[1] In order that the foregoing statement might not be considered that of a Northern theorist without practical knowledge of the subject, it has been submitted to several experienced cotton-growers in the South; and, after the correction of some minor errors by those to whom it was first submitted, it has been finally indorsed by a gentleman of great experience in the cultivation and purchase of cotton, both before the war and since, now residing in Middle Georgia.

He adds, in the following letter, valuable facts in regard to the effect of better cultivation on the habit of the cotton plant itself: —

"I have been glad to peruse your valuable document, and I am unable to suggest a line of criticism upon your statement.

"I do not consider sheep culture as profitable in the central portions of Georgia and South Carolina, as in the more northern and more southern localities.

"It is my opinion, the South has ten per cent less labor in the cultivation of cotton than prior to our civil strife. In slavery, women, boys, and girls ploughed and hoed: now the work of ploughing is by able men generally, the hoeing and picking by women and children; but quite a percentage of the latter do not now work in the field.

"We have an increase of white labor, especially in the more northern latitudes of our States (with a climate suited to the white man). Formerly it was supposed that in this section the seasons were too short and the climate too severe for cotton culture, and under the old method of culture such was true; but the use of fertilizers, more attention to the saving of barnyard manures, combined with the better methods of preparing and cultivating, have hastened the maturity of the plant and fruit so that the crop is fully one month earlier than in *ante-bellum* times.

"Old lands in cultivation for half a century can be restored by the application of top-soil from the forest of any upland plantation. Leaves decomposed, if properly applied, will give a beneficial result for about five years, by which time the forest will give a new supply of the same material. This, composted with cotton seed and acid phosphate, is the cheapest fertilizer; and barnyard manure adds materially to its value. This compost is a complete fertilizer for corn and cotton.

"The forty acres you inquire of have been in cultivation for half a century. Seven years ago they would not have produced over one bale to three acres; but, by the application of barnyard manure from eighteen animals, with ten bushels of cotton seed per acre, and one hundred and fifty pounds of pigs'-feet bone ground to a powder, annually applied, they have given a good result each year, until fifty-two bales, of four hundred and sixty-two pounds each, were gathered, and probably eight were lost by rot in the last cotton year.

"For the past few years the acid phosphate has been used; and at this time, but for the caterpillars, this field would give one and one-half bales per acre. The dried pigs' feet, ground into a powder, is the best and most durable of commercial fertilizers.

"If our planters would rotate their crops, oats followed by cow-pease, — the latter returned to the earth, — less of rust to cotton would be the result.

"Thorough, deep ploughing in the preparation, and shallow ploughing in the cultivation, have as much to do with the quick growth and good yield of cotton as the commercial fertilizers."

COTTON MANUFACTURES.

The cotton manufacturers of the United States may be now considered more firmly established than ever before. The method on which the business is conducted in the United States varies greatly from that of any other country; and this difference arises mainly from a difference not only in the habits and customs of the people, but also in their condition and intelligence.

The home market is the most important one, and may long continue to be so, although the export demand for our fabrics now takes seven to eight per cent of our annual product, and is likely to increase.

In contrast with the cotton manufacturers of Great Britain, our principal rival, we are therefore called upon to meet the demands of an intelligent class of customers living under substantially uniform conditions, and varying but little in their requirements. Hence we are not called upon for the great variety of fabrics that must be supplied by Great Britain. In consequence of this demand for a great variety of fabrics, the work of the cotton manufacture of England is much more divided than with us. With the exception of a few large establishments, working mainly to supply the home market, few goods are known in England by the name of the factory in which they are made, or are sold under the name of the manufacturer; but to a very large extent the yarn is spun in one establishment, woven in another, and finished in a third. The gray cloth is sold to the warehouseman, or to the merchant, to be stamped and packed by him, or to be dyed, bleached, or printed under his direction. If English goods had been sold under the name and stamp of the manufacturer, as cotton goods are in the United States, perhaps the substitution of clay for cotton might not have been carried to so great an extent. In the United States cotton goods are spun and woven in the same factory, and, whether sold in the gray or bleached, they are almost all stamped and marketed under the name of the factory in which they are made. Each factory, therefore, has its reputation to be sustained, and, whether the fabric be coarse or fine, it is the effort of every one to make it good of its kind.

The same rule applies to printed calicoes. They are mar-

keted under the name of the works in which they have been printed; and the reputation and permanent existence of the works rest upon uniformity in quality, excellence in color and style, and constant progress in the art of design.

We may not claim to be more honest than our rivals, but it is a great error to suppose that it is permanently profitable to make an article that is not what it purports to be. A cotton fabric may be of a low grade, and may be intended to sell at a low price, but yet it is not profitable to substitute clay for cotton: the fabric, whatever it is, has its name and reputation, and must be true to them, or else the demand for it will cease sooner or later. Even goods that are made for linings, and that need to be starched and stiffened in order to be used, must have a uniform quality in the fabric itself to hold a permanent place in our market. Dyed goods that require to be woven on heavily sized warps, cannot be loaded with sizing, except by rule. If an attempt is made to introduce an article in which clay has been added to make it heavier, it is immediately detected; because the use of sewing-machines is almost universal, and the clay in the fabric heats the needle, and exposes the fraud.

It has therefore happened, that, although we have not until recently undertaken the manufacture of very fine fabrics, the average quality of the fabrics that we do make is better than that of any other nation, with the possible exception of France. It is for the wants of the million, that our cotton factories are mainly worked; and we have ceased to import staple goods, and shall never be likely to resume their import. On the other hand, we may for a long period continue to import the finer goods that depend mainly on fashion and style for their use, and that are purely articles of luxury. As has been stated, the substantial fabrics that constitute the main part of our cotton manufacture, and that are used by the masses of the people, are of the best of their kind, with the possible exception of those made in France. The French peasantry are a sagacious and truly economical race, and will not buy a poor fabric if they can get a good one; hence the cotton fabrics for their use are of a very substantial kind, and much more free from adulteration than those of any other country in Europe. The common cotton fabrics of England, Belgium, and Germany, could hardly be sold in the United States at any price.

The finest printed calicoes of France and England may be the best of their kind; but the printed calicoes for the use of the multitude, and which constitute the really important branch of this department of the manufacture, are of much better quality in the United States than in Europe, and are also of finer colors and more varied styles.

In fact, one of the chief obstacles that it has been necessary to overcome in the introduction of unbleached American cotton fabrics in the English market, and in other markets heretofore supplied by England, has been their apparently open texture, owing to the absence of heavy sizing. In the United States the sizing used upon the warp, and which is necessary in order to weave it, is made from corn or potato starch, free from any substance intended to make it heavier. In the gray cloth the sizing therefore constitutes only two and one-half to five per cent of the weight, and when the fabric is washed it shrinks more in measure than it loses in weight; hence a square yard washed and dried without stretching will be heavier than a square yard taken directly from the loom.

In England, on the other hand, even the pure sizing is made from wheat-flour, which is very glutinous; and the fabrics thus woven, even where no adulteration is intended, lose ten to twelve per cent of their weight on the first washing. These pure goods are, however, made chiefly for the home consumption of the richer classes of England. The greater part of the English cotton fabrics exported or used by the working classes are loaded with clay and other substances, from ten to forty per cent. The art of sizing has been highly perfected in England, and has been made the subject of very numerous patents; and, as the use of clay and flour to the extent of one hundred pounds to each one hundred pounds of cotton warp yarn involves great danger of mildew, many ingenious chemical applications have also been patented to serve as antiseptics; such as chloride of zinc, chloride of calcium, common salt, white vitriol, &c. These various antiseptics are compounded with flour, gypsum, soap-stone, China clay, and other heavy substances, in various ways. The English text-books upon the art of sizing are instructive and suggestive, especially in respect to the rules for the purchase of the most glutinous kinds of flour, and for the detection of *adulteration* in the flour; it being obvious that unless the flour is pure, and well adapted to the

purpose, it would be necessary to use cotton instead of clay to make up the weight of the fabric.

It will of course take a good deal of time to accustom buyers to the more open texture of cotton fabrics in which no clay is used; but, as time passes, American fabrics are being steadily substituted for those previously used by foreign nations, especially in China.

Since the year 1860 the cotton manufacture of the United States has been exposed to greater vicissitudes than any other important branch of national industry; and the wonder is not that there should have been some disasters, but that it should have survived at all in the hands of its original owners. In 1860 the whole number of spindles in the United States was 5,235,000. From 1857 to 1860 the cost of constructing a spinning and weaving factory on medium fabrics woven of No. 25 yarn was from $16 to $20 per spindle. (The number designates the number of skeins, of 840 yards of yarn each, in one pound.) The value of a bale of cotton of 480 pounds was $40 to $50. Then came the combined effects of war, paper money, and scarcity of cotton. At one period, more than two-thirds of the cotton machinery of the United States was stopped; the value of a bale of cotton rose to over $900, and the price of some kinds of goods was seven to eight times the present price. A little later new mills were constructed, which cost $30 to $40 per spindle.

At the present time, September, 1879, there are not less than 10,500,000 spindles in the country, and each spindle is more effective than that of 1860; the value of the bale of cotton is again $40 to $50; the standard printing-cloth, which reached thirty-three cents a yard during the war, is worth four cents; the No. 25 mill for spinning and weaving can be built for $12 to $15 per spindle; our export of cotton fabrics is more in value and much more in quantity than in 1860, and the only check to its steady and profitable increase is the renewal of the home demand. Such have been the changes and fluctuations; yet, despite them all, not one spindle in ten has passed from the ownership of the person, firm, or corporation in whose possession it was in 1860, except in the regular process of bequest or voluntary sale.

During the period of inflation or of great vicissitude, the attention of the managers of the property was of necessity

devoted to other matters than the improvements and minute savings in which the profit of the business now consists; but during the last few years very great improvements have been made, and the lesson of economy and saving has been learned. The best example that can be cited may be found in the record of one great factory working upon coarse and substantial fabrics, and consuming more than 20,000 bales of cotton a year. Sixty per cent of its product is sold for export to various parts of the world.

The proportion of operatives to each thousand spindles has been decreased forty-three per cent, or from twenty-six and one-half to fifteen.

The wages of women, who constitute more than two-thirds of the operatives, have been increased thirty-three per cent.

The cost of making the cloth, aside from the material used, has been decreased twenty-one per cent.

In 1860 the average product of one operative, working one year, was 5,317 pounds; in 1878, 7,928 pounds of drill, such as is exported to China. Assuming five pounds, or about sixteen yards, as the annual requirement of a Chinaman for dress, in 1860 one Lowell operative, working one year, clothed 1,063 Chinese; in 1878 one could supply 1,586. It will be obvious that no hand spinning and weaving can compete with this product of machinery; yet the machine-made fabrics of Europe and America combined have as yet reached only six or eight in a hundred of the Chinese. How soon the rest will be clothed in cotton fabrics made by machinery from American cotton, therefore, depends but little on whether the wages of the Lowell factory-girl be four or six dollars per week, but rather on what exchangeable products the Chinese can produce better or cheaper than we can. The more tea, silk, sugar, and other commodities we buy from them, the more cotton fabrics, and other products in which we excel, will they buy from us.

It has been held that the cotton of America must be more and more used, both in America and elsewhere, and that, as time goes on, almost every other kind, with the exception of the cotton of Egypt, must give place to it.

To what extent may the same pre-eminence be secured for the cotton fabrics of the United States in the markets of the world, that we have secured in respect to the cotton fibre?

In the consideration of this branch of the subject, our atten-

tion must be given to the present condition of competition between the mills of the Middle and Eastern States with the mills of Great Britain.

In respect to the Eastern States, the cotton factories of Lowell, Mass., Manchester, N.H., Biddeford and Lewiston, Me., may be considered in their relation to the factories of Manchester, Stockport, Preston, and Bolton, in England. For the purposes of this comparison it may be assumed that there can be no permanent advantage of one set of mills over the other in respect to the quality and perfection of the machinery. At any given time, some advantage may be claimed and admitted on either side, in some special department of the mill; but every invention or improvement will sooner or later be adopted on both sides.

The supremacy in the art of converting cotton into cloth must ultimately fall to that country or section that possesses the advantage in respect to the conditions offered to the operatives, and in proximity to the source of the raw material.

The best conditions of life for the operatives, and the best prospect of improving their condition and that of their children, are of the gravest importance. The factors in this problem are education, shelter, subsistence, and opportunity for other kinds of work. In respect to education, the common-school system of the United States assures a thorough training, free of cost; and in the principal towns and cities free education is carried to the point of preparing the pupil to enter a university.

In respect to the subsistence, the factories of New England are three thousand miles nearer the wheat-fields and grazing-grounds of the West than those of Lancashire; and, so long as Europe buys food of America, our own mills must have the advantage of proximity to the Western prairies. In respect to the rents of dwelling-houses, there cannot long be any difference if there is any at present; because the materials for construction are most abundant in America. Opportunity for other work than that of the factory must continue for many generations, and until this continent is peopled.

In comparing our power to compete with England, we may claim advantages of one kind, and with the nations of continental Europe advantages of another, in some respects of a different order. In competition with England it is often

claimed that our chief advantage lies in a certain alleged versatility and power of adapting means to ends, and in great quickness of perception on the part of working-people in respect to the advantages to be gained by the adoption of new processes or inventions. If we have this advantage, there must be special causes for it in the influences that are brought to bear upon the operatives and artisans who do the work; for a very large proportion of them are foreign-born, or are the children of foreign immigrants. Why should they work with any more zeal or judgment here than in the countries whence they have come? Why are Irish and French Canadian factory-hands to be relied on for more steady work, larger product, better discipline, and more cleanly and wholesome conditions of life, than the operatives of England, Belgium, and Germany? To the writer it appears evident that these advantages, so far as they exist, are due mainly to the following circumstances: —

First, Our system of common and purely secular schools, attended by the children of rich and poor alike.

Second, Manhood suffrage.

Third, The easy acquisition of land.

Fourth, The habit of saving small sums, induced by the establishment of savings banks throughout the manufacturing States.

Fifth, The absence of a standing army, and the application of the revenue derived from taxes on the whole to useful purposes.

In respect to the first of these influences, the public-school system, the foreign observer generally takes notice only of the quality of the instruction given, and, though he may find something to praise, he finds also much to blame; he finds in many cases the instruction bad, and the subjects often ill-chosen, and he wonders at the misdirection of a force that might be so much more wisely applied. What he fails to notice is that the school itself, entirely apart from its instruction, is the great educator of the children who attend it. The school is, first of all, no respecter of persons: the stupid son of a rich man, led in every class by the son of a mechanic, cannot in after-life look down on him as an inferior, whatever the conventional position of the two may be; or, if the rich man's son have brains as well as fortune, the poor man's son can never attribute to fortune only the lead that he may take in after-life. The school is thoroughly

democratic, and each pupil learns in it that it depends on himself alone what place he may take in after-life; and that, although society may be divided into planes, there is no system of caste, and no barrier in the way of social success, except the want of character and ability to attain it. The associations of the common school utterly prevent any thing like servility in the relation of classes in after-life; and although it is sometimes made a little too manifest that "one man is as good as another, and a little better," on the part of those who are more eager than discreet in their effort to rise, yet, on the whole, the relation of the various classes, which must in the nature of things always and everywhere exist, is that of mutual respect, and any thing like the Old World distinctions of caste and rank would seem about as absurd to one as to the other. The common school is the solvent of race, creed, nationality, and condition.

In another way the discipline of the school affects the processes of manufacture. In the schools, cleanliness, order, and regular habits are enforced, with deference to the teachers, and respect for authority; and in these later years coupled with the teaching of music and drawing in all the principal towns and cities. When children thus trained are removed to the mill or the workshop, habits of order and cleanliness, with some æsthetic taste, are already established. Nothing strikes an American manufacturer with so much surprise as the extreme untidiness of the large textile mills of England, and the dreariness of the factory-towns. In this respect, however, it must be confessed that the managers of the New England mills are greatly aided by the absence of smoke, the coal commonly used being anthracite. Much surprise is often expressed by our foreign visitors at the amount of decoration permitted in the fitting of stationary and locomotive engines, and in much of our machinery; but, bad as the taste displayed may sometimes be, it is nevertheless a fact that such engines or machines are better cared for and kept in better repair than where no individuality, so to speak, is permitted. On one of our great railways the attempt was not long since made to despatch the locomotives as they happened to arrive at the central station, sometimes with one and sometimes with another engine-driver; but the immediate and great increase in the repair-account caused the corporation to return very soon to the customary plan of giving each driver his own locomotive with which he may be identified.

The instruction of the school also gives every pupil a superficial knowledge, if no more, of the geography and resources of the country, which the universal habit of reading newspapers keeps up. Hence comes the almost entire absence of any fixed character in the labor of the country: every boy believes that he can achieve success somewhere else, if not at home. No congestion of labor can last long. The war and the succeeding railway mania combined concentrated population at certain points to a greater extent than ever happened before, and it has taken five years to overcome the difficulty; but within these five years a million new inhabitants in Texas, half a million in Kansas, and probably a million and a half added to the population of Nebraska, Colorado, Minnesota, and the far North-West, indicate that the evil has already found a remedy.

It is already apparent that a very slight increase in the demand for skilled workmen in certain branches of employment would not easily be met in the Eastern States, except by drawing upon England and Germany. During the years of depression, the cessation of railway-building, and the use of the excess of railway plant existing in 1873, has caused the dispersion of a large portion of the trained mechanics and artisans who then did the work of supplying this demand; but these are not the men who have crowded the Eastern cities, and caused the apparent excess of laborers out of work: such men have gone back to the land, or in the new States and Territories have found other ways in which to apply their skill and energy, and they will not return. It may be that the greatest danger to the manufacturers of England will not be in our competition in the sale of goods in neutral markets, but in our competition for the skilled workmen and artisans who make these goods, when we again offer them equal or higher wages, and better conditions of life, in the work that will very soon need to be done to supply the increasing demand in our own country.

The patent system may here be cited also as a factor in our industrial system. It has been carried to an almost absurd extreme; so that it is not safe for any one to adopt a new method, machine, or part of a machine, and attempt to use it quietly and without taking out a patent, lest some sharp person, seeing it in use and not published, shall himself secure a patent, and come back to the real inventor with a claim for royalty.

Manhood suffrage — subject as it is to great abuses, and dif-

ficult as it has made the problem of the self-government of great cities where voters do not meet each other, as in the town-meeting, face to face, but where the powers of government are of necessity delegated to men of whom the voters can have little personal knowledge — yet works distinctly in the direction of the safety, stability, and order of the community. Outside of two or three of the very largest cities, where there are concentrated great masses of illiterate *foreign-born* citizens, it would be difficult to find a case of serious abuse of the power of taxation, except in the South, since the war, where the evil is now mainly abated.

The easy acquisition of land throughout the country, under simple forms of conveyance, registered in every county, gives a motive to economy, and induces habits of saving that are of supreme importance in their effect on society. In the town in which the writer lives, — and in which he himself can remember the coming of the first Irishman who became a land-owner, — out of about one thousand owners of real estate, over two hundred are of Irish birth or extraction. The richest one among them came from Ireland in 1846, a steerage passenger. He now pays taxes on property of the value of fifty thousand dollars, almost all in real estate; his son is superintendent of the repairs of highways, and one of the most efficient members of the school committee.

During the last thirty years, the factory population of New England has passed through three phases. First came the sons and daughters of the New England farmer; but, as the sewing-machine and other inventions opened new demands for women's work, women of American birth passed out to easier or better paid employments, while the men took up other branches requiring more individual skill. Their places were taken mainly by Irish, with a few Germans and English. But as the Irish saved their earnings, and as the New England yeomen emigrated to the richer lands of the great West, they passed out of the mills to buy up the deserted farms of the poorer North-eastern States, where, by their persistent industry and manual labor, they achieve success, and gain a position which satisfies them, but with which the native New Englander is no longer contented. Their places in the mills are now being more and more taken by the French Canadians, who, in their new conditions and surroundings, show little of the stolid and unprogress-

ive character which has kept them so long contented on their little strips of land on the St. Lawrence River. In the very air they breathe they seem to imbibe a new and restless energy, while the intelligence shown by their children in the schools augurs well for their future progress. On the whole, the simplicity of our system of land-tenure, and the ease with which small parcels may be obtained, must be rated among the most important factors in considering our possible advantage over other countries.

Next in our list comes the savings bank. In 1875, out of the sixteen hundred and fifty-two thousand inhabitants of Massachusetts, seven hundred and twenty thousand were depositors in savings banks to the amount of two hundred and thirty-eight million dollars (£49,000,000). During the late years of depression the deposit has decreased somewhat in amount, but the decrease has been chiefly owing to the withdrawal of money for other investment, especially in United States bonds. There have been some failures of banks, and some losses, as might well have been expected; but they have been less than in any other branch of business; and the savings-bank system stands firmly based on well-earned confidence, and offers an easy means of saving the smallest sums to every man, woman, and child in the State.

To these causes of quick adaptation to any conditions that may arise, or to any necessity for the application of new methods or devices, may be added the custom, which has almost the force of law, of an equal distribution of estates among the children of the testator. *Tools to him who can use them*, is the unwritten law; and neither land nor capital can remain long in the possession of him who cannot direct or use them wisely. Liberty to distribute is esteemed as important a factor in our body politic as liberty to accumulate, even though the liberty may sometimes lead to the apparent waste of great fortunes.

Finally, it must be held that our freedom from the blood-tax of a standing army, and the fact that the proceeds of taxation are, on the whole, usefully and productively expended, are among our greatest advantages; and this is asserted with confidence, notwithstanding the misgovernment of some great cities, and of several of the Southern States. What are these failures but proofs of the general confidence of the people in local self-government? Great frauds and great abuses can only happen

where integrity is the common rule: where each man distrusts his neighbor, or each town, city, or State distrusts the next, the opportunity for fraud or breach of trust cannot occur. The use of inconvertible paper money during late years has not been without its necessary malign result upon the character of the people, and the newspapers are filled with the fraud and corruption that have come to light; but no newspaper has ever yet recorded one fact that offsets many frauds. In the great Boston fire, one of the Boston banks lost, not only every book of account, but every security and note that was in its vaults, amounting to over twelve hundred and fifty thousand dollars. On the morning after the fire, its officers had no evidence or record by which any of the persons or corporators who owed it money could be held to their contracts: yet, within a very short time, duplicate notes were voluntarily brought in by its debtors, many of whom knew not whether they could ever pay them, because the fire had destroyed their own property; and the ultimate loss of that bank, from the burning of its books and securities, was less than ten thousand dollars.

Our army is but a border-police; and, although its officers are held in honor and esteem, military life is not a career that very many seek; and, as time goes on, it will become less and less an occupation to be desired. Thus we are spared not only the tax for its support, but the worse tax of the withdrawal of its members from useful and productive pursuits. It is in this respect that we claim our greatest advantage over the nations of continental Europe. What have we to fear from the competition of Germany, if we really undertake to beat her in the neutral markets which we can reach as readily as she can? For a little while the better instruction of her merchants, in her technical and commercial schools, may give her advantage; but that can be overcome in a single generation, or as soon as the need is felt with us, as it is now beginning to be felt. After we shall have supplied our present want of technical education, the mere difference between the presence of her great army on her soil and its necessary support, and the absence of such a tax on us, will constitute the difference on which modern commerce turns, when the traffic of the world turns on half a cent a yard, a cent a bushel, or a halfpenny a pound, on the great staples. No nation can long succeed in holding the traffic, that is handicapped with a standing army. The protection of Ger-

many from our competition in neutral markets may be offset in our yet more dangerous competition for men. The German already knows Texas; and, in the one block of sixty thousand square miles of land by which the State of Texas exceeds the area of the German Empire, we offer room and healthy conditions of life for millions of immigrants. And on that single square of land, if they come in sufficient numbers, they can raise as much cotton as is now raised in the whole South, — that is to say, five million bales; and as much wheat as is now raised in the whole North, that is to say, four hundred million bushels, — and yet subsist themselves besides on what is left of this little patch that will not be needed for these two crops.

It will be obvious that even the least imaginative cannot but be moved by the influences that have been designated, and that versatility and readiness to adopt every labor-saving device will not only be promoted, but absolutely forced into action, when such vast areas are to be occupied, and when even the dullest boy is educated in the belief that he also is to be one of those who are to build up this nation to the full measure of its high calling. We may not dare to boast, in view of all we have passed through; but we know that slavery has been destroyed, and that the nation lives stronger, truer, and more vigorous, than ever before. We know that it has been reserved for a democratic republic to be the first among nations that, having issued government notes, and made them legal tender, has resumed payment in coin without repudiation or reduction of the promise. We know that we have paid a third of our great national debt already, and that the rest is now mainly held by our own citizens. We know that within the lives of men of middle age now living the nation will number one hundred millions, and that, in whatever else we may be found wanting, we cannot long be kept back in our career of material prosperity, which shall be shared with absolute certainty by every one who brings to the work health, integrity, and energy.

If there is any force in this reasoning, our competition with other manufacturing countries, in supplying neutral markets with manufactured goods, will not be compassed by low rates of wages paid to our factory-operatives, or to the working-people engaged in our metal-works and other occupations, but first by obtaining and keeping such an advanced position in the application and use of improved tools and machinery as shall

make high wages consistent with a low cost of production; secondly, by our ability to obtain the raw materials at as low or lower cost. Every employer knows that among employés who are paid by the piece, it is the operative that gains the largest earnings whose production costs the least, because under the control of such operatives the machinery is most effectively guided during working-hours. As it is with single operatives, so it is with large masses, — if well instructed, and working under the incentives to industry and frugality that have been named, their large product will earn for them ample wages, and yet result in low cost of labor to the employer. Such workmen never have any "blue Monday." The workman who in this country habitually becomes intoxicated is soon discharged; and his place is filled by one who respects himself, and values his place too much to risk his position in dissipation.

Competition with England in supplying the markets of Asia, Africa, and South America with cotton goods, is now perhaps the best criterion by which to gauge our ability to compete in other branches of manufacture. It has been often assumed in England, that the increasing shipments of cotton goods from this country have been forced by necessity, and merely consisted of lots sold below cost as a means of obtaining ready money; but there is no ground whatever for this general assumption, even though some small shipments may have been made at first with this view. Our export of cotton fabrics amounts as yet to but seven or eight per cent of our production, and is but a trifle compared to that of Great Britain; but it is not made at a loss, and it constitutes a most important element in the returning prosperity of our cotton mills. The goods exported are mostly made by strong and prosperous corporations, paying regular dividends. They consist mainly of coarse sheetings and drills, and are sold by the manufacturers to merchants, who send them to China, Africa, and South America, in payment for tea, silk, ivory, sugar, gums, hides, and wool. They are not made by operatives who earn less than the recent or present rates of wages in England; but, in most departments of the mills, by those who earn as much or more. This competition had been fairly begun before the late war in this country, but it is now continued under better conditions. The mills of New England are now relatively much nearer the cotton fields than they were then, owing to through connections

by rail. Prior to 1860 substantially all the cotton went to the seaports of the cotton States, and from there the cost of moving it to the North or to Liverpool varied but little; but at the present day a large and annually increasing portion of the cotton used in the North is bought in the interior markets, and carried in covered cars directly to the mills, where the bales are delivered clean, and much more free from damage and waste than those which are carried down the Southern rivers on boats and barges, dumped upon the wharves, and then compressed to the utmost for shipment by sea.

In proof that this advantage is an actual one, the following example may be cited: A contract has just been made in this city for the transport of a large quantity of cotton from Texas to Liverpool, at the rate of $1.10 per hundred pounds, — the proportion assigned to the land carriage being seventy cents; to transhipment in Boston and to the steamship, forty cents; the rate of marine insurance is three-eighths per cent; and the cost of handling in Liverpool, and transportation to Manchester, not less than a quarter of a cent per pound. Bargains may be made to bring cotton from the same point in Texas to the principal factory cities of New England, at the rate assigned to the land carriage, namely, seventy cents per hundred pounds. This cotton is brought from the interior towns of Texas to Boston, and cannot be carried to Liverpool by way of Galveston or New Orleans so cheaply, else it would not come this way. Assuming the bale to weigh five hundred pounds, at ten cents a pound, we have the following comparative cost: —

LOWELL.			
Cost of cotton in Texas, 500 pounds at 10 cents, including all local charges	$50 00		
Freight to Lowell in a covered locked car, in which the cotton is protected from rain, mud, and other causes of waste, at 70 cents per 100	3 50		
Total	$53 50	10	70
LANCASHIRE.			
500 pounds at 10 cents, including all local charges	$50 00		
Freight from Texas to Liverpool, at $1.10 per 100 pounds	5 50		
Insurance at three-eighths per cent on $56	21		
Transhipment in Liverpool, and freight to Lancashire, one-fourth cent	1 25		
Total	$56 96	11	39
Advantage of Lowell over Lancashire			69

There may be changes in the rates, but it does not seem probable that the relation of the land to the ocean can be much changed; and it would therefore appear that the New England manufacturer will have a permanent advantage in the price of American cotton of any given grade, varying from six to eight per cent, as the price of cotton may vary from twelve to nine cents per pound; and this advantage may be equal to twenty-five to fifteen per cent in ability to pay wages, as the cost of labor varies from a quarter to a third in the total cost of coarse and medium goods, such as constitute the chief part of the demand of the world.

It may be said that this proves too much, and that the cotton spinners of the Southern States will have the same relative advantage over New England. Let this be freely admitted: we are treating the question of the future supremacy of the UNITED STATES in the manufacture as well as the growth of cotton; and if the future changes in population, wealth, and condition of the different sections of this country, shall in the future cause the increase of spindles, especially in coarse fabrics, to be planted in the healthy hill country of Northern Georgia, Eastern Tennessee, and the Carolinas, it will simply be the greater evidence that natural laws are paramount. If Georgia has twice the advantage over Lancashire that New England now possesses, it will only be the fault of the people of Georgia if they do not reap the benefit of it.

It has been stated that our present rates of wages in our cotton factories are higher than they were in 1860, and, with our increasing prosperity, they will tend to advance; but at the same time the cost of the labor in the finished fabric *has been reduced by the greater productive power of the machinery.* The fabrics upon which by far the largest part of the spindles and looms of the country are operated may be divided substantially into the following classes: —

1st, The printing-cloth, twenty-eight inches wide and seven yards to the pound. The cost of mill labor in making this fabric, including the salaries, wages, or earnings of every one employed, is now less than one cent, or a halfpenny, a yard.

2d, The heavy sheeting, thirty-six inches wide, and the heavy drill, thirty inches wide, both weighing two and three-fourths to three yards to one pound. The cost of mill labor in making these fabrics is about one and one-fourth cents per yard.

3d, Shirtings and sheetings, thirty to thirty-six inches wide, Nos. 20 to 30 yarns, weighing three to four yards to a pound. The cost of mill labor in these goods is from one and a half to two cents per yard.

4th, The fine sheeting or shirting, thirty to forty inches wide, No. 30 to 40 yarn, weighing three to four yards to the pound. The cost of mill labor in these goods is from one and a half to three cents per yard.

5th, Fabrics of a similar kind to the above, from one to three yards wide.

6th, Heavy cotton duck, cotton grain-bags, cotton hose, and other special articles.

7th, Blue denims, stripes, tickings, brown denims and duck, and other heavy colored goods, substantial ginghams, cottonades, and other fancy woven fabrics of medium or heavy weight.

These seven classes comprise more than ninety-five per cent of our cotton fabrics in weight; to them are to be added lawns, woven fabric of light weight for dresses, and spool-cotton.

In respect of one-half of these fabrics, being those of the heavier grade, our proximity to the cotton field, computed at not less than half a cent per pound, oftener three-quarters, will enable the New England manufacturer to pay from twenty to thirty per cent higher wages, and yet to make the goods, other things being equal, at the same cost as his competitor in Lancashire. On a large portion of the other kinds, this advantage in the cost of cotton would be ten to twenty per cent.

The natural advantages cannot work immediate results: the ways and means of a great commerce cannot be improvised in a year, hardly in a generation. Much depends on the wisdom of our legislators in framing the acts under which our taxes are collected, whether customs or excise, and yet more upon our adherence to a specie basis in our currency; but in the long-run the only reason why we shall not assume a constantly increasing share in the cotton manufacture of the world will be the free choice that our country offers for other occupation of a more profitable or more desirable kind.

Reference has been made to the small proportion of fine spinning in the United States. Within the last few years great progress has been made in spinning and weaving fabrics of Nos. 60 to 100, such as lawns and fine dress-goods, and also in spinning fine yarn for spool-cotton. In the latter direction, yarns

as fine as No. 120 are now spun on the ring spinning-frame, a machine invented in this country, and more used than any other for warp spinning, and now being adopted in Europe. Yarns as fine as 550 are spun on mules for three-cord sewing-cotton, and for experiment much finer counts have been reached. It has often been alleged that fine yarns could not be as well spun in the United States as in England, owing to the dry and electrical conditions of the atmosphere during a considerable part of the year. This difficulty has existed in some degree, although not so as to preclude fine work if it had been profitable to undertake it; but, as far as this difficulty existed, it has lately been entirely removed by the invention of a very simple and inexpensive apparatus for moistening the air with the finest spray of pure cold water, by which method the air of a spinning or weaving room may be kept at any desired degree of humidity in the dryest day, so that the adverse effect of electricity is entirely overcome.

Whenever the condition and extension of our market will warrant the undertaking, there is now no obstacle to our manufacturing any variety of cotton fabric that is in demand, either coarse or fine.

The following examples will give an adequate idea of the construction and general appearance of American cotton factories, and of the dwelling-places of the operatives: —

[The completed work will be illustrated with steel engravings of several of our best mills.]

The following examples will give an adequate idea of the mode of construction of American cotton machinery and other apparatus connected with cotton mills, nearly all the diagrams being of machines that are in some respects peculiar to this country. [In the completed work diagrams and descriptions will be given of such machines as the following.]

The Kitson opener; Whitehead & Atherton lapper; Foss & Peavey card; Whitin Machine-shop card (self-stripper); Saco Water Power Company roving-frame; Sawyer ring spinning-frame; Whitin ring spinning-frame; Fales & Jenks Manufacturing Company Rabbeth spinning-frame; Mason mule; Lowell slasher; Lewiston warper; Lyall loom (wide); Empire loom (fast); Knowles loom (fancy); Blake pump; Parmelee automatic sprinkler; Fales & Jenks Manufacturing Company rotary pump; Holyoke Machine-shop water-wheels; Garland moistener.

It is suggested that the complete work, of which this publication is a specimen, may be made more complete in the department of cotton and cotton manufacturing, if persons interested will communicate additional information or suggestion to the undersigned. E. A.

BOSTON, October, 1879.

[From "The American Architect" of Sept. 20, 1879.]

THE VIBRATION OF MILL BUILDINGS.

BOSTON, September, 1879.

TO THE EDITOR OF THE AMERICAN ARCHITECT.

Dear Sir, — Assuming that a large factory or machine-shop is to be constructed upon the slow-burning principle, with open timbers, plank floors, deck roof, &c., there remain other points to be considered, which do not appear to have yet received sufficient attention from either the mill-engineer, the professional architect, or the builder.

In many of the existing mills, even of apparently the best construction, there is a great tendency to vibration; and in some of the mills that are high and narrow, the vibration is very great. When it is considered that the lateral motion which constitutes this vibration has been imparted to the whole structure, and that it causes a pressure of every bearing in the mill, first on one side and then on the other, it will be obvious that a great deal of power must be wasted, not only to induce this motion, but also to overcome the additional friction caused by it, especially in heavy bearings.

If the common method of constructing a factory be considered, its faults may be apparent, and possibly the remedy. Assume an ordinary mill, 350 to 500 feet by 72 feet, four or five stories high, with towers to brace the centre only; throughout the greater part of the length the section showing two rows of posts and two side walls, with no brace whatever to prevent them from yielding or bending in some degree either way. There are mills within our knowledge in which a pail of water two-thirds full cannot be set upon the upper floor without slopping over; others in which gas-pendants will sway from side to side more than two inches. One mill was lately inspected, of unusually good construction, built of stone, with arched brick floors, four stories high, carrying very heavy machinery for working flax. On the first floor of the mill it was observed that the gas-pendants hung from the second floor had a very marked swing from side to side. We have the record of another large mill construction with iron beams, in which, before the machinery could be operated with

any success, it became necessary to put wooden beams under the iron, and to lift the iron from the brick walls so that all the bearings should come upon the wood.

This vibration has been attributed chiefly to the motion of the looms; and it is now customary to place looms across the mill, and not lengthwise, and also upon a lower floor, as far as possible. In some cases one-half the looms are operated at a little lower speed than the other half, in order to avoid a synchronous movement of the lathes; but there are many other causes of vibration, even in the rotary motions of other machines and of the shafting, pulleys, and belts. Wherever there is friction there is a cause of vibration; and when it is necessary to construct a mill or workshop above one story in height, a remedy must be sought in the method of construction.

Mill construction appears to have been considered more with reference to the support of dead weight than to stiffness or absence of vibration. In point of fact, the dead weight to be sustained in a cotton or woollen mill is very little. If we take as an example a mill of 32,000 cotton spindles on No. 24 yarn, the floor space and dead weight of the machinery, omitting openers and pickers, which would, almost as a matter of course, be placed upon a concrete floor in a separate building, would be substantially as follows: —

COMPUTATION FOR A COTTON MILL OF 32,000 SPINDLES.

No. 24 Yarn.

	Pounds, about.	Total.	Stock.	Shafting.	Operatives.	Total Weight.	Floor Space.	Average Weights.
6 Lappers.....	12,000	72,000	280	13,000	300	85,580	In sep. build'g.	
240 36-inch Cards.....	1,600	384,000	4,800	11,920	275	400,995	17,856	23.80
2 Doublers.....	980	1,960	40	1,100		3,100		
12 R. W. Heads.....	800	9,600		1,100	180	10,880		
21 Drawing.....	2,000	42,000	850	1,250	180	44,280	5,184	8.52
36 Roving Frames.....	9,000	324,000	2,000	14,500	4,300	344,800	12,528	27.52
90 Spinning Frames, 176 Spindles each	4,000	360,000	15,340	125,000	1,820	502,160	15,984	31.42
24 Mules, 672 Sps. each	10,000	240,000	16,000	24,000	2,800	282,800	24,192	11.69
8 Spoolers	2,600	20,800	890	5,000	825	27,515	5,184	6.15
6 Warpers	450	2,700	760	410	500	4,370		
2 Slashers.....		4,000	5,600	2,200	480	12,280	5,760	26.66
8 Drawing-in Frames.	60	480	1,600		1,000	3,080		
800 Looms	800	640,000	128,000	140,000	16,000	924,000	36,864	25.07
		2,029,540	175,880	326,480	28,360	2,560,260	123,552	20.72
	Add for contingencies 20 per cent.....					512,052		
						3,072,302		24.86

The greatest concentration of weight is immediately under the

slashers; and, as the floor reserved around the slashers is used to pile loaded yarn-beams upon, the weight at this point is relatively much more than the figures show.

A mill floor constructed in the usual manner would consist of beams 12 by 14 inches in one or two parts, 8 feet on centres, 3-inch plank, 1¼-inch top floor. The material would usually be hard pine and spruce; this would be substantially equivalent to 6 inches of wood of uniform thickness. Spruce weighs 30 pounds per cubic foot; Georgia pine, 48 pounds. On these figures the floor described would be equal to 19½ pounds weight to each superficial foot of floor surface. If ¾-inch mortar were used between the floors, it would add about 6 pounds per square foot, — making 25½ pounds in all. The total weight of floor and load is, therefore, from 50 to 60 pounds per foot of surface in the principal departments of the mill. If the load be multiplied by 8, the standard of the beams would be to bear a breaking strain of 250 pounds per foot of surface, or 50,000 pounds on each beam 25 feet long, supporting 4 feet of floor on each side of the centre, — 200 square feet per beam. (An actual weight equal to this was lately found in a warehouse used for storing cheese.) The weight of the floor itself would be distributed about in the proportion of 7 pounds in the beams, and 12½ pounds in the plank and boards of the floor. These figures would be varied a little, according to the kind of timber and plank used. In a mill 72 feet wide in the clear, with two rows of posts, the beams must each be a little more than 24 feet long; and it is obvious that there must be a very great proportionate weight on the centre of each beam, and therefore a tendency to sag in the middle. What that means in respect to the adjustment of shafting, and the operation of machinery, every manufacturer knows to his cost and trouble.

How to stiffen the beams without exposing iron truss-rods, such as are commonly used, to the action of fire, — as the combustion of the contents only of almost any room of a textile factory would heat truss-rods so as to make them useless, and would probably heat and destroy iron beams, — would seem to be a suitable question.

The problem is, how to get the strength of iron and the slow burning of a heavy wooden beam. Objections are made by some engineers to composite beams of iron and wood; and it is not desirable to reduce the substance of the wood more than one-half, — that is, not to have either of the two parts of a beam much thinner or more combustible than the floor.

It is alleged that the weight upon a floor sustained by a composite or "flitch" beam will rest either on the iron or on the wood, and cannot be brought upon both together. If your correspondents have any data upon this point, it would be interesting to the mill constructors to know them.

It has been suggested that a factory may be braced with inside rods; but it is desirable to avoid rods, because of their tendency to collect lint.

The equivalent of the knees used in the construction of a ship has been suggested; but it is desirable *not* to tie the beams to the walls, so as to prevent the ends rolling out of their bearings in case they break or burn one at a time.

Buttresses would doubtless serve a good purpose, but they are somewhat objectionable if deep enough to obstruct light in the lower stories.

Our problem therefore is, how to construct the walls, either solid or hollow; how to brace the posts; and how to construct the beams so as to give the utmost stiffness, and so as to avoid vibration.

There are problems not yet solved in respect to the construction of the frames of machinery as well as of the mills, that would perhaps repay scientific study with a view to avoiding vibration, — a familiar example of the unscientific use of material being the original use of stone sleepers on the Lowell Railroad.

The problem of rightly combining wood and metal in the framework of rapidly moving machinery, and wood, metal, brick, or stone in the construction of the factory, appears to offer a wide field for saving in power, friction, wear, and waste.

These points are stated as indicating some of the points that might be well considered by the student of *industrial architecture*, and every attempt at architectural effect must be absolutely subordinate to them. The only true effect that can be rightly aimed at must be that which gives expression to these considerations of safety and utility.

E. A.

BOSTON, Dec. 15, 1879.

AMBROSE EASTMAN, ESQ., *Secretary.*

Dear Sir, — The official statement of the export of cotton fabrics for the fiscal year ending June 30, 1879, should be increased in the sum of about a million seven hundred thousand dollars, making that year the largest of record.

The change occurs because a correction of the figures compiled in the Bureau of Statistics in Washington has been made by a comparison with the import figures at Ottawa, Can.

This correction had been made at my suggestion, during previous years, but was overlooked this year. The attention of the authorities has been frequently called by the Chief of the Bureau of Statistics to the inadequacy of the export statement in respect to Canada.

Yours truly,

EDWARD ATKINSON.

REPORT

OF

SOME TESTS OF STRENGTH OF MATERIALS,

MADE AT

United States Arsenal, Watertown, Mass., upon 400-tons Testing Machine.

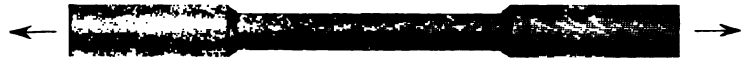
TEST FOR TENSILE STRENGTH OF FOURTEEN ROUND BARS OF SIEMENS-MARTIN STEEL, MANUFACTURED BY BENJAMIN ATHER & CO., NEWARK, N.J.; FINISHED BY AMES CO., CHICOPEE; USED FOR STEEL SHAFTING BY JAMES W. CUMNOCK, AGENT DWIGHT MANUFACTURING CO., CHICOPEE, MASS.

No. of Spec.	Part Tested.			Elastic Limit, lbs. per Sq. In.	Permanent Set under loads of		Ultimate Tensile Strength, lbs. per Sq. In.	Total Elongation after fractured.	Reduced Diameter at Fracture.
	Length.	Dia.	Sectional Area.		50,000 lbs. per Sq. In.	60,000 lbs. per Sq. In.			
	Inches.	Inches.	Sq. In.		In.	In.			Inches.
1	9.748	1.648	2.133	46,000	.003		93.790	16%	1.36
2	9.746	1.648	2.133	44,000	.004	.114			
3	13.973	2.798	6.1487	44,000	.001½				
4	13.968	2.798	6.1487	45,000					
5	12.500	2.646	5.4988	above 48,000					
6	12.493	2.646	5.4988	above 47,000					
7	12.496	2.4	4.5239	50,000					
8	12.501	2.4	4.5239	52,000					
9	12.496	2.152	3.6373	52,000		.075			
10	12.505	2.152	3.6373	50,000		.083			
11	12.378	1.804	2.556	45,000					
12	12.381	1.802	2.5504	49,000	.002	.144			
13	9.732	1.402	1.5438	56,000		.119	94.440	17.6%	1.08
14	9.740	1.404	1.5482	56,000		.107	93.070	14.6%	1.08

REMARKS. — Specimen No. 11 took permanent set with 46,000 pounds to a square inch, of .002 of an inch, which was not increased till 52,000 pounds to a square inch were reached, permanent set then being .003 of an inch; and this was not increased till 58,000 pounds

to a square inch were reached, when specimen elongated rapidly. A characteristic feature of all the above specimens is, they yield but slightly until a load considerably above the elastic limit is applied.

Fine granular appearance at fractures.



GENERAL FORM OF SPECIMENS.

TEST FOR TENSILE STRENGTH OF OUR BAR OF BEST NASHUA IRON.

[Specimen turned down from 2¼" bar.]

Length	9.664 in.
Diameter	1.654 in.
Sectional area	2.1486 pounds to sq. in.
Elastic limit	25,000 pounds to sq. in.
Permanent set, load 26,000 pounds to sq. in.	.026 in.
Permanent set, load 27,000 pounds to sq. in.	.046 in.
Permanent set, load 30,000 pounds to sq. in.	.091 in.
Ultimate tensile strength	49,150 pounds to sq. in.
Total elongation after fractured	28.9 per cent.
Diameter reduced, point of fracture	1.35 in.
Appearance at fracture	fibrous.

To make a comparison of the relative values of the Nashua iron and the Siemens-Martin steel for use as shafting, beyond the above tests of tensile strength, it is necessary to determine the torsional strength. The 400-tons testing-machine is at present unprovided with apparatus for torsional strains.

Professor J. E. Denton, of Stevens Institute of Technology, kindly furnished me with data of tests, which they had made of wrought iron and carbon steel, with tensile strength and limit of elasticity and elongation nearly the same as in above tests. The data furnished was from specimens $\frac{5}{8}$ inch diameter and .798 inch diameter. Making a direct comparison, by using the theoretical relations of "the cubes," we have as the torsional strength of specimens 1.65 inches diameter: —

	Ultimate Torsional Strength.	Elastic Limit for Torsion.
Siemens-Martin steel.	6,428 foot-pounds.	244 foot-pounds.
Nashua iron	1,894 "	662 "

These results are intended only as an approximate comparison; an actual test of the specimens for torsion might not justify some of my assumptions, which in the instance were obliged to be made.

Twenty circular Phœnix columns have recently been tested with strains of compression.

Dimensions of columns, about 8.04 inch external diameter, 10 inch diameter through rivets in flanges, 4 segments. Sectional area, about 12 square inches.

Lengths varying from 28 feet down to 8 inches.

The ultimate crushing strength of the 8-inch columns was 682,000 pounds; and for the 28-feet columns the ultimate strength was 420,000 pounds.

Independently of showing the uniformly high sustaining strength of these columns, the experiments were highly interesting, as developing the fact that "Gordon's Formula," which has long been employed in proportioning columns in important structures, does not give the true strength of the columns; the ultimate strength found by experiments being in excess for long columns of the computed strength. After the columns were considerably bent, they would still sustain a higher load than most specifications call for in straight ones.

The above report is made at the suggestion of Edward Atkinson, Esq., to be presented to the Cotton Manufacturers' Association for its consideration.

Respectfully submitted.

JAMES E. HOWARD.

JAMES W. CUMNOCK, *Agent Dwight Mf'g Co.*

[No. 28.]

N. E. COTTON MANUFACTURERS' ASSOCIATION.

PROCEEDINGS

OF THE

FIFTEENTH ANNUAL MEETING,

HELD AT BOSTON APRIL 28, 1880.

PRECEDED BY

CATALOGUE OF MEMBERS.

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FRANKLIN PRESS: RAND, AVERY, & CO.,
117 FRANKLIN STREET.
1880.

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1880.

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Henry Lippitt . . .	Social Manuf. Co.	Providence, R.I.
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John H. Nichols . .	Dwight Manuf. Co.	Boston, Mass.
Charles Nourse . .	Social Manuf. Co.	Woonsocket, R.I.
Franklin Nourse . .	York Manuf. Co.	Saco, Me.
Carlos Nudd . . .	. . . . .	Providence, R.I.
George H. Nye . .	Laurel Mills	Laurel, Md.
John C. Palfrey . .	Manchester Mills	Boston, Mass.
Francis J. Parker .	Monadnock Mills	Boston, Mass.
Walter E. Parker .	Globe Mill	Woonsocket, R.I.
John H. Parks . .	New Brunswick Cotton Mills,	St. John, N.B.
Theophilus Parsons .	Lyman Mills	Holyoke, Mass.
Charles S. Peach . .	Freeman Manuf. Co. . . .	No. Adams, Mass.
William D. Pennell .	Lincoln Mill	Lewiston, Me.
Haven C. Perham .	. . . . .	Lowell, Mass.
John M. Pevey . .	. . . . .	Lowell, Mass.
Moses Pierce . . .	Norwich Bleachery	Norwich, Conn.
Thomas Pray, jun. .	. . . . .	Boston, Mass.
H. L. Pratt . . .	Canada Cotton Manuf. Co. .	Cornwall, Ont.
J. E. Prest	North Pownal Manuf. Co. .	North Pownal, Vt.
J. M. Pusey . . .	Delaware Mills	Wilmington, Del.
T. G. Ramsdell . .	Monument Mills	Housatonic, Mass.
James Renfrew, jun.,	Renfrew Manuf. Co. . . .	Adams, Mass.
Roscoe C. Reynolds .	. . . . .	Lewiston, Me.
John Rhodes . . .	. . . . .	Millbury, Mass.
F. H. Rice	. . . . .	W. Boylston, Mass.
A. Robeson . . .	Fall River Print Works . .	Fall River, Mass.
William F. Salmon .	Lowell Hosiery Co.	Lowell, Mass.
H. Saltonstall . . .	Chicopee Manuf. Co. . . .	Boston, Mass.
Wm. G. Saltonstall .	York Manuf. Co.	Boston, Mass.

Eugene H. Sampson,	Everett Mills	Boston, Mass.
A. H. Saunders		Nashua, N.H.
Benjamin Saunders	Harbor Manuf. Co.	Nashua, N.H.
J. H. Sawyer	Appleton Co.	Lowell, Mass.
John Scott	Willimantic Linen Co.	Willimantic, Conn.
George H. Searle		Millbury, Mass.
E. M. Shaw	Lisbon Manuf. Co.	Lisbon, Me.
Thomas S. Shaw	Suffolk Mills	Lowell, Mass.
William F. Sherman,		Fall River, Mass.
Charles M. Shove	Granite Mills	Fall River, Mass.
George H. Simmons		Ansonia, Conn.
James B. Siner		Lawrence, Mass.
A. C. Slater	Linwood Mills	Whitinsville, Mass.
Robert R. Smith	Greenwoods Co.	New Hartford, Conn.
S. S. Spencer		Lancaster, Penn.
James C. Stanley	Greenwoods Co.	New Hartford, Conn.
Wilbur A. Stiles	Victoria Mills	Newburyport, Mass.
J. M. Stone		N. Andover, Mass.
Joseph Stone	Manchester Mills	Manchester, N.H.
Royal O. Storrs		Dedham, Mass.
E. A. Straw	Amoskeag Manuf. Co.	Manchester, N.H.
Henry D. Sullivan	Naumkeag S. Cotton Co.	Salem, Mass.
Charles J. Sweet	Attawaugan Mill	Killingly, Conn.
E. A. Thissell		Lowell, Mass.
Edwin R. Thomas	Clinton Manuf. Co.	Woonsocket, R.I.
Wm. H. Thompson	Lowell Felting Mills	Boston, Mass.
William E. Trainer	Linwood Mills	Linwood Sta., Penn.
E. E. Truesdell	China, Webs'r, & Pemb. Mills,	Suncook, N.H.
Albert F. Upton		Boston, Mass.
James Waring	Narragansett Mills	Fall River, Mass.
J. W. Wattles	Neponset Cotton Factory	Canton, Mass.
T. B. Wattles	Chicopee Manuf. Co.	Chicopee Falls, Ms.
John Webster	Newmarket Manuf. Co.	Boston, Mass.
George W. Weeks	Lancaster Mills	Clinton, Mass.
Francis M. Weld, jun.,	China Mills	Boston, Mass.
Henry F. West	Washington Manuf. Co.	Gloucester, N.J.
Channing Whitaker,	Mass. Institute Technology	Boston, Mass.
Nelson D. White	N. D. White's Mills	Winchendon, Mass.
Wm. E. Whitehead		Lowell, Mass.
W. J. Whitehead	V. Hudon Cotton Manuf. Co.,	Hochelaga, P.Q.
Charles E. Whitin	Whitin Manuf. Co.	Whitinsville, Mass.
Charles P. Whitin		Whitinsville, Mass.
George M. Whitin	Whitin Manuf. Co.	Whitinsville, Mass.
Harry T. Whitin	Rockdale Mill	Northbridge, Mass.
William H. Whitin	Whitin Manuf. Co.	Whitinsville, Mass.
A. N. Whiting	Whiting Mills	Oakdale, Mass.

Wm. H. H. Whiting	. . . . .	Boston, Mass.
William S. Whitney,	Pocasset Manuf. Co. . . .	Fall River, Mass.
Chas. L. Wilder, jun.,	Pioneer Mills	Meridian, Miss.
Thomas Wilmarth .	Dyerville Mill	Providence, R.I.
A. L. Williston . .	Greenville Manuf. Co. . . .	Northampton, Mass.
Hubbard Willson	. . . . .	Cordaville, Mass.
George Wood . . .	Millville Manuf. Co. . . .	Philadelphia, Penn.
William B. Wood .	Continental Mills	Boston, Mass.
C. J. H. Woodbury	. . . . .	Boston, Mass.
Eben Wright . . .	Thorndike Co.	Boston, Mass.

Total number Honorary Members	2
" " Active Members	217

CALL FOR MEETING.

NEW-ENGLAND COTTON MANUFACTURERS' ASSOCIATION,
BOSTON, April 1, 1880.

DEAR SIR, — The stated Annual Meeting of the Association will be held at the Massachusetts Institute of Technology, Boylston Street, Boston, on Wednesday, April 28, 1880, at ten o'clock, A.M., for the choice of officers for the ensuing year, and the transaction of such other business as may properly come before it.

An afternoon session will be held, beginning at two o'clock.

The committee appointed at the last meeting to further consider the subject of TARE ON COTTON will present its report for consideration.

In addition to former topics of discussion, the Board of Government have invited CYRUS I. BARKER, Esq, of Lewiston, Me., to state the result of his experience and observation in the CONSTRUCTION AND COVERING OF MILL ROOFS.

It is hoped that the members generally will come prepared to state their various conclusions upon this subject, of importance to all manufacturers.

FREDERICK GRINNELL, Esq., of Providence, R I., will explain the system of HEATING MILLS BY OVERHEAD PIPES, which has been introduced recently with favorable results.

An early and full attendance is invited.

By order of the Board of Government.

AMBROSE EASTMAN, *Secretary.*

PROCEEDINGS.

PURSUANT to the foregoing notice, the meeting of the New England Cotton Manufacturers' Association was held at the Institute of Technology on Wednesday, April 28, 1880, at ten o'clock A.M.

The president, Mr. A. D. LOCKWOOD, occupied the chair.

The PRESIDENT. Before proceeding to read the records of the last meeting, I will read a note I have just received from our secretary: —

BOSTON, April 28, 1880.

DEAR SIR, — For the first time in fifteen years' service as secretary, I regret to find myself unable to be present at the meeting of the Association, being engaged in a jury trial before the Supreme Court. I have requested my young relative, Mr. Robert Batcheller, who presents this, to act as my representative at the meeting; and I hope no inconvenience may result from my enforced absence.

AMBROSE EASTMAN, *Secretary.*

If there is no objection, I shall consider it the sense of the meeting that Mr. Batcheller represents Mr. Eastman as secretary on this occasion.

On motion, the reading of the records of the last meeting was dispensed with.

The secretary *pro tem.* — Mr. Robert Batcheller — read the reports of the secretary, treasurer, and auditor.

The foregoing reports were accepted, and ordered to be placed on file.

The PRESIDENT. The next business in order is the election of officers for the ensuing year. It has been customary to raise a committee to nominate. Shall the same course be pursued this year? If there is no objection, such will be considered the sense of the meeting.

On motion, the nominating committee was appointed by the chair, and consisted of the following gentlemen: Messrs.

SAMUEL WEBBER of Manchester, N.H., FREDERICK GRINNELL of Providence, R.I., and E. S. DAVIS of Lewiston, Me.

The PRESIDENT. Before that committee retires, I desire to occupy your attention for a moment, to say that I appreciate most highly the honors which you have so often conferred upon me, by electing me to the various positions which I have held as a member of the Association, and particularly the position that I hold at present; and having said thus much, and desiring to thank you for these honors, I now wish to say that I am no longer a candidate for the office of president. Hence I desire that this committee, in making their nominations, will consider that as my wish and my purpose fully.

Mr. BARKER. I rise for a similar purpose. For some five or six years past I have been one of the Board of Government; and I rise for the purpose of thanking the Association for the honor conferred in the past, and wish not to be considered a candidate for future election. Living so far away as I do, I cannot meet with the Board, and cannot attend to the duties which the office requires.

The PRESIDENT. During the absence of this committee, it will be proper to receive and act upon nominations for new members, if there are any names to be proposed.

The following gentlemen, upon nomination, were then elected members of the Association: —

WILLIAM AMES	Peterboro', N.H.
FRANK ATKIN	Lawrence, Mass.
WILLIAM C. AVERY	Lowell, Mass.
GEORGE S. BROWN	Providence, R.I.
EDWARD N. BURKE	Lowell, Mass.
GEORGE CALLAHAN	Philadelphia, Penn.
CHARLES L. HILDRETH	Lowell, Mass.
JOHN M. HULL	Providence, R.I.
JOHN MURPHY	New Haven, Conn.
A. F. NAGLE	Providence, R.I.
THEOPHILUS PARSONS, Jun.	Fall River, Mass.
JAMES RENFREW, Jun.	Adams, Mass.
F. H. RICE	West Boylston, Mass.
WILLIAM A. STILES	Newburyport, Mass.
WILLIAM J. WHITEHEAD	Hochelaga, P.Q.

Upon his request,

N. W. FARWELL of Lewiston, Me., was granted leave to withdraw from the Association.

The PRESIDENT. While the Committee on Nominations is out, if any gentleman would like to present his views upon any subject not embraced in the printed circular, we would be glad to give him an opportunity. I see there is a loom presented for some purpose. If the owner of that has any thing to say in regard to it, the Society will be interested to hear from him.

Mr. ATKINSON. I brought that loom down to be presented this afternoon. I take this opportunity to say, that last year an invitation was extended to members of the Association to visit the Art Museum, either on the day of the meeting or the next day; but, for want of some directions to the janitor of the Art Museum, gentlemen who went on the next day did not get in without paying. I desire to apologize for that little oversight, and to say that any of the members present, giving their names as members of the Association, will be very welcome at the Art Museum; and those who are obliged to stay over until to-morrow, and would like to go to-morrow, will find complimentary tickets on the table, which will admit them to-morrow. As I stated at the last meeting, there is a very interesting textile exhibit gradually gathering in the Art Museum, which you will be interested in.

To take up a very few minutes time, I will say that your Association has sometimes been interested in the work done in the mechanic-art shop of this Institute. I always have an axe to grind for the Institute, on every opportunity; and I now desire to call the attention of the members of the Association to this set of examples of work done by one of the boys in the mechanic-art school, during the past eighteen months. The examples are contained in this flat box, and consist of forgings, and the like. They are not among the best examples of work done by pupils who had no experience, previous to entering that school, in the use of the hammer or anvil; neither are they the worst. They are the work of a skilful pupil, who, from accident, had been obliged to hasten his work, otherwise it might have been better. They are a fair average of the work of the school. The examples of forging contained in this case, which extend up to and include the forging and preparation of steel tools for work in the turning-shop, represent in all twelve and a half full days' work of ten hours each, — the boy beginning with the first lesson in building a fire, and going on with instruction in blacksmithing and in forging, the work

divided into three lessons per week of three hours each, for fourteen weeks, aggregating twelve and a half days of ten hours each; in that time he has brought his skill in the art of forging up to the point of being able to make these steel springs and steel tools for use in the turning-shop. They are forged, tempered, and finished. The whole work, including the filing, the moulding, and the turning, that is represented on this table, occupying a period of instruction included within eighteen months, represents twenty-two days' work of ten hours each, — two hundred and twenty hours of work.

Bear in mind that this young man is at the same time pursuing the instruction that would form a part of the course of instruction in a good high school, — in algebra, geometry, in mechanical drawing, in English, and perhaps French, — I am not sure about that; but the instruction that would be given in a good high school is carried on at the same time that this hand work is being taught. I think you will be interested to examine these examples of work, and that you will find that some good mechanics are being prepared, both in the use of their hands and in the use of their heads. The description of the examples lies upon the box.

REPORT OF THE COMMITTEE ON NOMINATIONS.

Mr. WEBBER. The Committee on Nominations have directed me, as their chairman, to state that had it not been for the declination of the President, they would have had no hesitancy in renominating him; but knowing him to be a very decided man, and very positive in his adherence to what he says, they have decided to accept the resignation, and pay him the compliment in that manner, and not go through with the form of renominating him, and accepting his declination afterwards. The committee have directed me to report the following nominations: —

For President, JOHN KILBURN of Lowell, Mass.

Vice-Presidents, A. G. CUMNOCK of Lowell, Mass.; CHARLES NOURSE of Woonsocket, R. I.

Directors, HERVEY KENT, of Exeter, N. H.; DAVID J. JOHN-

[NOTE BY THE SECRETARY. — MR. CUMNOCK, subsequently to the meeting, resigned the office of vice-president; and the Board of Government, on June 2, 1880, filled the vacancy thus created, as provided by the By-Laws, by the election of Mr. GOULDING as vice-president.]

STON, of Cohoes, N.Y.; CHARLES L. LOVERING, of Taunton, Mass.; RICHARD GARSED, of Philadelphia, Penn.; WILLIAM F. GOULDING, of Lewiston, Me.; WILLIAM H. JENNINGS, of Fall River, Mass. The report was accepted.

Mr. SAMUEL WEBBER was appointed to cast the ballot for the Association for the list of officers presented.

The persons named in the list were unanimously elected to the several offices to which their names stand affixed.

In the absence of the newly elected president, Mr. CHARLES NOURSE of Woonsocket, vice-president, took the chair, and presided during the remainder of the meeting, — having first returned his thanks to the Association, for the honor conferred upon him, in appropriate remarks.

TARE ON COTTON.

The CHAIRMAN. The first regular item of business, as appears by the printed notice, is the report of the committee appointed at the last meeting to further consider the subject of the TARE ON COTTON. If that committee is ready, its report will now be in order.

Mr. GOULDING, in behalf of the foregoing committee, presented the following

REPORT.

At the meeting of this Association in October last, we had the honor of making a report to you upon the subject of selling cotton gross instead of net; and endeavored to show that the system was wrong, and worked only evil to all parties.

The discussion that followed the reading of that report took a wide range, embracing the bad condition of the cotton bale from being exposed to bad weather, rolled in the mud, and purposely increased in weight, both of bagging and needless hoops. The discussion also developed a diversity of opinions as to the main fact of complaint; viz., that the American spinner was at disadvantage with the foreign spinner, in the buying of American cotton gross, while the foreigner bought the same net.

The agitation and discussion of this question was not begun at that meeting, neither by this Association; but has been for years before the various cotton exchanges, manufacturers, and even State legislatures. The persistent refusal of all foreign buyers to buy cotton gross, the universal custom of buying

every thing else net weight, and the years that have passed while this matter has been discussed by the ablest men in our cotton exchanges and among our manufacturers, would certainly imply that a wrong was being perpetrated upon somebody.

In our previous report, we took the ground that the American cotton spinner was the sufferer. There are those, however, who claim that the American cotton spinner *gains* a trifle by buying American cotton gross, as compared with the foreign spinner who buys it net.

If there is no *loss* to us (to say nothing about a trifle gained), the inquiry would naturally arise, Why all this talk about cotton tare, for the last fifteen or twenty years, by men in the cotton exchanges and among cotton manufacturers? Why was this subject referred to a special committee by this intelligent body of manufacturers, if we are on an equality with all the rest of the world in this matter?

There are those, also, who claim that the buying of cotton gross, instead of net, not only does no damage to us, as compared with those who buy cotton net weight, but that the selling of cotton gross is a damage and loss to the cotton planter. This proposition, coming as it does from a source entitled to the highest consideration, was certainly new to your committee, and I think will be new to most of this Association; but it is based upon the following statement, viz.: "Everybody has to buy cotton on gross weights; and just so far as the foreign buyers reduce the price to cover the loss of tare, they reduce it as surely and as much for the American as for themselves. If it were the fact that six per cent is the equivalent of actual tare, justice would be done by this method, as exactly as by tare allowance, and with less trouble. But actual tare is, in its usual average, less than five per cent, as six per cent is an arbitrary dictum, adopted to guard against the occasional wrong-doing of dishonest packers. The difference is lost to the planters as it is gained by the consumers; and the amount of loss, say, upon a crop of five and a half millions of bales, valued at ten cents per pound, amounts to $2,250,000, or about one per cent. It is not strange that cotton planters should have believed that they profit by the present system, when, until very recently, a large majority of merchants and manufacturers have held the same belief. When the planters shall see, as merchants and spinners have discovered, that what the planter

gains in weight he loses in price, and more too, and this on every bale of the crop, and that they must continue to bear this loss until they establish a rule of actual tare, and that a just reproach rests against them and all of us, for sustaining a system, both wrongful to everybody and hurtful to themselves, they will doubtless move for a reform in the only quarter where reform is practical, — in the Southern legislatures."

If we admit that there is no difference to us in the final result of buying cotton net or gross weight, here is a reason to influence legislative or other action on the part of the cotton planters; and it is fair to suppose that when the planters see that it is a damage to them to sell bagging and hoops for twice as much as they cost them, they will immediately make a rule to discard the six per cent allowance, and sell all cotton net, or with *actual tare*. This Association may or may not feel called upon to do missionary work at the South, — to put $2,250,000 into the pockets of the cotton planters.

Your committee still think that the buying of cotton gross is wrong, and they have not found anybody to defend the system. This Association referred this matter back to this committee, with a request that they should recommend "some definite plan." This we find more difficult to do than it is to discuss and speculate upon the moral and financial reasons why it should be done.

But your committee will venture to suggest: —

That the cotton *buyers* of New England be urged to move in the matter of buying cotton net weight, by immediately fixing some arbitrary rate of tare, until the cotton *sellers* will arrange for actual tare. Mr. Atkinson said, at our last meeting, that "it is in the power of thirty or forty men in the country to establish net weights, if they can make a combination." Your committee believe this, and it seems an easy solution of a difficulty that is admitted to be of sufficient importance to call for such a combination.

While we might recommend this, that, or some other course, a practical solution of the difficulty appears before us to-day, in the shape of the cotton bale of the future, coming from the Cotton Economy Company of New Haven, Conn., where the successful cotton-gin of Whitney originated. And your committee would call especial attention to this method of baling cotton, which we understand has been found to be practical as an economic method, both to planter and spinner.

A bale of the cotton referred to will be found here on the platform, and it will be desirable for all who can to examine it.

The report of the committee was accepted.

Mr. ATKINSON. That report being before the Association, I desire to call more attention to this bale, which you see is not a very heavy one. That was lent to me by our friend Mr. Johnston of Cohoes, a few weeks ago, to place in our office where it might be seen. I then endeavored to have the representative of the Cotton Economy Company of New Haven here to-day. If he is here, I hope he will make himself known. I have seen him but once, and I am not sure I should recognize him if I saw him now. The company I find to have been started upon the right basis, i.e., to make a profit for themselves in improving the methods of packing cotton at the South. They started in a moderate way, and by an ingenious method, in an ordinary freight-car of about forty feet in length. I understand that they placed a needle-point gin in the middle of the car, and a Dedrick hay-press (a description of which I see you have had placed upon your seats). That press has revolutionized the packing of hay. I understand it packs lap by lap. In the other end of the car, I believe they had their counting-room; and in that car they made an expedition to Texas, switching off at the proper places, buying the cotton in the seed, ginning and packing it in this method. I understand this bale to be about thirty pounds to the cubic foot. I am not perfectly sure of my data (I had hoped to have had the report here, which was promised to me); therefore my figures are general, and not particular. I understand this bale to be about thirty pounds to the cubic foot; that the ordinary compressed bale of cotton is about twenty pounds to the cubic foot; and that this, having been pressed lap by lap, is found not to be injured in any manner whatever. It is then tied with wire ties upon the cotton, and put into the bag, which may be taken off and used over again several times. Mr. Johnston says, in regard to it: —

OFFICE OF HARMONY MILLS, COHOES, Dec. 26, 1879.

EDWARD ATKINSON, ESQ.

Dear Sir, — I send you to-day one bale of the new process cotton. The sack is not to be cut off, but opened at one end and slipped off, and returned to be refilled, thus saving so much.

This cotton was ginned on the needle-gin, and delivered in a sheet, and not blown into a room, to make three grades from the same seed. There is

a saving also of two or three per cent of dust in this manner. It is then fed on a perpetual press, each armful being fully pressed, as fed, the cotton being actually compressed less for the thirty pounds per square foot than the ordinary compressing to give twenty pounds. This cotton is from North Texas, where the cottons are quite short, and not good staple and body, this season. As I have not seen the seed cotton, cannot say if it is much or little injured in the gin. The tare is less than half the ordinary baling, and one-third more can be loaded in a car. There may be some objections to this plan; but it is a step in the right direction, and should be thoroughly tested. For home consumption the staple should come to us with less loss. Bale weighs 112 pounds.

Yours truly,

(Signed) D. J. JOHNSTON.

Examples of this same lot have been sent to Massachusetts Cotton Mills. I hope Mr. Battles is here to say a word upon it: he expected to be. Other samples have been sent to Nashua, and there worked. I have found by the report that the two companies differ a little on one point. One thinks it is a little more work to handle these bales, and the other thinks it is less. I believe both agree that there is no substantial injury to the cotton, but that it works well.

In this connection there may be present Mr. Lenox, of the Washburn & Moen Manufacturing Company, who will present to you either to-day or in the report reasons for adopting the wire tie in place of the hoop-iron tie, — a very large saving, both to the planter and the manufacturer. These undertakings, in the direction of profit for those who inaugurate them, and pointing at profit both to the planter and the manufacturer, are steps in the direction of abating the present barbarous method of treating cotton. I think nobody would be likely to abuse a bale of that sort. It tells of itself that it ought not to be thrown in the mud or left out in the rain. If Mr. Lenox is here, I should be glad to have him present a paper, of which he submitted the proof to me, on the substitution of wire for iron hoop. Mr. Leigh points out that it would be a very good business to weave cotton bags instead of jute bags, for this purpose. If the report of the Washburn & Moen Manufacturing Company, which I expected to have here to-day, is not here, I suggest that liberty be given to have it printed in the report of the meeting, for I think it is a matter of great interest to all the members.

Mr. LOCKWOOD. I have a little doubt of the propriety of

printing a paper, on so important a subject as that, from an outside party, — a paper that has not been read. We know nothing about it.

Mr. ATKINSON. If the paper comes in, and cannot be read to the Association, it will be referred to the Board of Government with authority to print if they see fit.

Mr. LOCKWOOD. I see no objection to that. We might otherwise be unconsciously indorsing something which we did not desire to.

Mr. SCATTERGOOD of Albany. As the needle gin has been mentioned here, I would like to offer you a needle gin, or section of it, and a saw from a saw gin, in order that you may see why the needle gin is superior to the saw gin in handling cotton. I lay the articles before you on the table. *This* is the Whitney invention. *That* is what Whitney tried to do, in his first efforts, for inventing the gin. I have accomplished the object with this apparatus; and this will show the difference between the Whitney invention and the present one. I leave these specimens with you to be examined.

Mr. ATKINSON. I understand that the Dedrick Press Company intend to carry their compression of cotton to the extent that shall make it of the density of oak, or forty-eight pounds to the cubic foot. It is suggested that we pass these matters until afternoon, and take up the other items upon the programme.

CONSTRUCTION OF ROOFS.

The CHAIRMAN. The next item for your attention is the matter of the construction of roofs, by Mr. BARKER of Lewiston, Me. If he is present, we will be happy to hear from him.

Mr. BARKER. — I have been requested to relate to the Association my experience in regard to cotton-mill roofs; and, as I did not feel quite adequate to the situation, I have prepared a paper, giving my ideas upon the matter, which I will read.

The covering of roofs must vary according to the climate, and the uses for which the building is designed.

In constructing a mill roof in a country where the temperature ranges from twenty degrees below zero to a hundred above, with heavy rains and deep snows, the matter of covering the roofs of cotton mills becomes of great importance. Roofing material that would answer a good purpose in Georgia might

not be suitable for a roof in New England. A building with a flat roof might be a desirable thing in Philadelphia, while the same constructed roof would not stand the deep snows of Maine. Therefore different localities call for different forms of roofs, and different materials to cover the same. In a very hot and dry climate it would be desirable that the covering should be a non-conductor of heat, such as earth ,thatch, or slabs of marble; while in a cold and wet climate it is desirable to have a roof for protection against water, and at the same time have something durable.

This brings us to consider the best form and material to be used in constructing a cotton-mill roof in our section of the country. The best form in my judgment is a pitched roof, height not less than a quarter to a third of the span, covered with two and a half inch pine plank, planed, jointed, and tongued, and well seasoned, the same covered with first quality slate.

If the mill is to have a flat roof, it should have a pitch of one inch per foot, rafters every eight feet; should cover it with two and a half inch plank of fair quality, free from large and unsound knots, the plank to be well seasoned, planed, and grooved for tongues, the knots to be shellacked, and nail-heads to be counter-sunk an eighth of an inch, and filled with putty. Would cover the roof with best quality "M F" tin, without using paper. Before the tin is put on, would have each sheet painted on under side with two coats of red lead, giving it at least four weeks to dry and become perfectly hard. When the tin is put on, all nails to be covered and protected, so none shall show or be exposed; after the roof is completed, and washed so as to remove the acid in soldering, would give the roof two coats of red lead. By having the work carefully and well done, we have the best, most durable, and cheapest covering for flat roof. I know of no material now in use that I consider suitable to put on as a covering to a flat roof except tin. Have had some experience with the gravel roofs, having now under my charge quite a large amount of gravel roofing. It has given us trouble, and that continuously: therefore I consider the gravel or composition roof the most objectionable and least desirable of any material. I could give many reasons why a gravel or composition roof is not desirable with us, but will not take up the time, as I should only be repeating what many of you are

familiar with who have gravel roofs; viz., leaky roofs, calling for constant repairs. Therefore, in my judgment, the best material for covering a roof is slate or tin.

[On motion, the foregoing report presented by Mr. Barker was accepted.]

Mr. LOCKWOOD. Having heard from away down East, I would like now to hear something from the Middle States, particularly from Mr. Garsed of Philadelphia. I hope he will give us his experience.

Mr. GARSED. I don't intend to occupy much of your time here to-day, but to give way for some new spirits. But as I have been called upon by Mr. Lockwood to say something about gravelled roofs, having had twenty-six years' experience with one, on a one-story mill, I can only say, that, if properly put on, I think a gravel roof will last from twelve to fifteen years, and not leak a drop of water. The last two or three years we have repaired the roof on a mill one story high, some five hundred feet long, and sixty-six feet wide. I think I can say positively that not a single drop of water has gone through since that repairing. We put a man on, by the by, to repair it by the day, one of our own workmen, who was not a practical gravel-roofer, but a carpenter whom we had had in our employment some time. I found it was the common practice in repairing gravelled roofs to simply scratch off a little of the gravel, patch up with some pitch, and put gravel on top, without considering whether the felt beneath may not have been destroyed by contraction, or by persons walking on it, and cutting it through. In other words, the roof was not, as our Lewiston friend says, well put on: the repairing of the roof, and painting of it, — that is quite as essential with a gravelled roof as it is with a tin roof. If the gravelled roof has, in the language of Mr. Barker, the same attention as the tin roof, I believe it to be just about as good a roof. That is my impression about it; and, if I were building another mill to-morrow, I should put on a gravelled roof.

Mr. BARKER. I knew the subject would open discussion; for it is, above all things about a mill, one of those things that have given us the most trouble. As my friend Garsed from Philadelphia has emphasized the words "well done," and "well put on," I was about to ask him how that "well done" is to be. I hold in my hand a bill which I suppose is from one of the most

respectable firms certainly in New England having to do with roofing. This was an after-thought: I happened to think of it as I came away. I presumed the same question that Mr. Garsed has raised would arise. In June, 1871, I had a roof at the Bates Mill put on by the New England Felt and Roofing Company. It was put on "extra;" for the one that was on before had lasted only about three years, and rotted the boards under it. They re-covered it, and did as they chose in every way and manner. We furnished the material, less the paper and tar; and they warranted it to last six or eight years without any repairs. That roof has been put on twice since, and I dare say to-day no man can travel over it with safety. That is to say, he is liable to step through. Our experience there has been that tar and gravel roofs serve to rot the boards; and the boards or planks, or whatever they are put on with, become in a very short time decayed, and have to be repaired. I would like to hear if there is any better way than the way this was put on, for I think it was done very nicely.

Mr. GARSED. In the case I was speaking of, the boards are exactly the same boards that were put on that mill in 1853. They were white pine, planed on both sides, painted only on the inside, I think, tongued and grooved together, and I know of nothing else that has been done to it. Not a single board has been taken out, to the best of my knowledge and belief. Now, while I am on the floor I would say that you must not understand that a gravelled roof had any thing to do with the plank's rotting. I mean to say that if you are going to make a mere roof of plank, and cover it either with gravel or tin, if any member of the Association will make one as Mr. Barker has described, and put gravel on top of it, I venture to say it would be one of the best roofs in this country. I don't believe a single plank or board has been taken off that roof of mine which was put on there in 1853; nor is there any evidence of decay. It may be, and it is very probable, that the tar and pitch used in this roof of which Mr. Barker has spoken were of an inferior quality, or the paper itself manufactured from something inferior. It seems, from the gentleman's description, that there must be something in the material itself which destroyed it: there is certainly nothing in coal-tar or tarred paper to rot the boards upon which it is laid. I cannot imagine what it was, unless they added an acid to it which

destroyed the material of the paper. I can only reiterate that in the case of the roof I have described, while we have repaired it and covered it over with paper thoroughly, we have not removed a single piece of timber.

Mr. WEBBER. I have had a good deal of experience in regard to roofs. Unfortunately, not knowing what it was to come up to-day, I have not any statistics with me; but my experience in Manchester has been about on a par with that of Mr. Garsed. We like gravelled roofs so well that in the new mills that are building to-day we are putting them on. In 1859 or 1860, I took off the tin from the roof of the Manchester Print Works, where it had become completely rotted by acid that came up from the print-works. Although repaired since, the main bulk of the roof stands as in 1860. The roof-boards have never been taken off. The Amoskeag Mills have altered their roofs from a pitch roof and slate to a flat and gravelled roof. In 1871 they rebuilt their No. 3 mill, taking off the pitch roof, and putting on a gravelled roof, which has stood thus far perfectly well; and the new Amory Mill just built has had a flat roof put on. I have seen in Boston the roof-boards rotten; and I can imagine that putting on a gravelled roof where there was acid, putting it upon unseasoned boards, might cause a decay of those boards. Our work was not done by any of the roofing companies: it was done by a regular slater, the one that did all the work for the town.

Mr. GOULDING. I had a bit of experience within a few days or a week, that perhaps will interest some gentlemen here. I take this opportunity to mention it. We contemplated, in the Androscoggin Mills, building a large storehouse. Among the very nice things I thought I was doing, by way of making a safe, fire-proof building, was to make a slate roof. In consulting with an officer of a leading insurance company, which insured the building, he said to me, "What kind of roof are you going to put on?" I said to him, "Slate." He said, "Don't put on a slate roof." Said I, "What shall I put on?"—"Any thing but slate," said he. I supposed a slate roof was a safe thing. He adduced a great many reasons, which I will not undertake to repeat, why a slate roof was a bad roof; and he recommended, as probably the best roof I could put on, shingles laid in mortar. I see that there is a reporter here who has a broad smile on his face when I speak of "shingles

laid in mortar," but it is no joke. I have known for a great many years, of shingles being laid in mortar for roofs. I presume in some sections of country it is very common. It is a roof possesses very preservative qualities, and fire-insurance companies have insured them very cheaply. The shingles might burn off from the roof, through an adjacent fire, without injuring the plank of the roof.

A MEMBER. I would suggest an improvement on the tin roof, — that it be laid on planks so that it will not pull apart from the contraction.

ANOTHER MEMBER. In regard to the expansion of tin roofs, I may say this: that after an experience of twenty-five years in laying such roofs, I have learned that if you will paint the roofs white, there will be no necessity for this expansion and contraction. The roofs will remain perfectly flat as originally laid.

ANOTHER MEMBER. I think the insurance men are perfectly right in the matter referred to by Mr. Goulding. In the thirty-odd years that I have lived in Fall River, I have seen where shingles caught fire from the locomotives on the railroad, and where they have taken fire from the rockets on Fourth of July nights, and I have seen the shingles burn off, we will say two feet, — from one to two feet, — and the fire has gone out of itself, because the shingles were laid in mortar, as I believe they are on all our mills.

Mr. BARKER. In regard to mortar, I would say that a few years ago we built a building, and I was requested to lay the slate in mortar, as a protection against fire. I did it. Each year since then, I should say from ten to fifteen per cent of those slate have come off; until last year it became a perfect bore from the slate dropping down. I made inquiry of the best slater we had in our section of the country, what was the matter. He said the lime in the mortar ate the nails off, and let the slates down, — which looked very reasonable; and hereafter I should not put mortar under slates.

In regard to the matter which my friend from Manchester spoke of, in regard to gravelled roofs, I don't know that there is any value in my theory upon this matter, but I think there is somewhat. The roof I put on our woollen mills, which I spoke of, was put on with good materials, and well done: there is no doubt about that. When it leaked, or when it came to repairs, and we had occasion to re-roof, we would find, underneath this

felt, the boards or planks saturated with water. You could take a piece of plank that was rotten, and twist it in your hand. I inferred, that, the paper being put upon the roof and pasted down tightly, it was then air-tight, i. e., for the time being. They put on one sheet, and ran along with a lot of tar, and, as it were, shingled it up. When they have finished, and put tar over the whole, if there is any moisture in the mill, which comes up, it has no way of escape when it reaches the paper: hence it remains there, and decays the boards. Last summer, on another roof we had occasion to cut a hole through; and we found, though it was in dry weather such as we ordinarily have during the summer, those boards were completely saturated with water, and decayed. It seems to me that would be an answer upon the question of durability.

Mr. JENNINGS. I find, in looking through the list of Fall River mills, that out of thirty-three corporations, twenty-three use the gravelled roof. I find that there is no mill built at the present time, where a pitch roof, or a barn roof as you term it, is used. All are gravelled roofs.

At the Merchants' Mill, the first roofing which I put on was in 1867, thirteen years ago. We have had few places that have required repair. We have had the roofing done much better than at that time. Wherever we had used the hard pine, or the spruce in the roofing, as Mr. Barker suggests, having it grooved and put on as he suggests, there we find that we have got along very nicely. But wherever we have undertaken to use the soft pine, or the northern pine and coarser material, we have had it to rip off. I have in mind now a mill built in 1872 or 1873, the roof being of this open, coarse pine, when they had to renew much of it. I don't know of a single instance in Fall River, where we have used the Western or Southern pine, that we have ever had to repair a roof. I don't know of a tin roof in the whole city on a cotton mill.

Mr. LOCKWOOD. Having been called upon to give my views upon the subject, and having rather for the time being thrown off the responsibility upon my friend from Philadelphia, perhaps I ought to occupy a moment or two. When our friend from Fall River was on the floor, the mentioning of the name of his city brought to my mind the statement that I heard not long since from a man who is also connected with fire insurance, who had been there in the performance of his

duty in the inspection of mills; and while there, or in going there, or on the train, he fell in with a man from Fall River whose business it is to cover roofs with gravelled roofing. During the conversation the question was asked, what price he charged for roofing. He gave the price, which seemed to the gentleman, who was a practical builder of long experience, a pretty low price; and he wanted to know if he could make a good roof at such a cost, and made some inquiries as to the material he used. "Well," said he, "we cannot make such roofs, or put on such roofs, as they used to. They cost too much. We have to put on roofs at such prices as people are willing to pay; and they cut us down to a lower price, and we use a cheap material." Now, I imagine that that is the case with a great many persons who use gravelled roofs. Their troubles arise often from the improper manner in which the work is done, and the poorness of the material that is used for the purpose. Now, if I were to have a gravelled roof, I should want, as has been suggested by Mr. Barker, a good substantial plank covering to begin with. I agree with him that that should be "splined." I also believe that the plank should be seasoned. That is important. You take white pine or some other kinds of timber, and saw it, half sap, and green, and put it to such a use, and it is not strange that it should decay. I have never had any trouble, I think, in the decaying of the wood. I have had a good deal of experience and a good deal of trouble with roofs. Sometimes I have favored mortar and shingles, a method in vogue thirty years ago. I have used the gravel roof, and I have had a good deal of trouble with that. I have also used tin, and have substituted tin, as in the case of the Androscoggin Mill, for a gravelled roof. The gravel lasted in that case eight or ten years. It was then covered with tin, and is, I think, in good condition to-day. It is supposed that the material — coal tar — now generally used for gravelled roofs, is not as good as formerly. It is also believed that tin in common use is of a poorer quality. If you are to have a good roof, either tin or gravel, you must have the planking well seasoned and properly laid, the material of suitable quality, and the labor performed in the most thorough manner. You should secure the best material, without regard to cost. I am now constructing a building four hundred and fifty feet long, and about a hundred feet wide; and this matter was one that interested me very

much. I had my objections to tin on so large a roof, — especially such tin as is now made. I had had a wretched experience with some of the gravelled roofs, and yet I had known other roofs where they had given great satisfaction and lasted many years. After considerable investigation and a good deal of thought, I adopted this, — whether it is the best or not, time will perhaps develop, — I adopted the gravelled roof, not, however, using as the material, the ordinary material, — I don't know as I ought to say "ordinary," but what a great many use, simply coal tar, paper, and gravel. I decided to use Trinidad asphalt with the gravel. It was at a higher cost, but that was not the principal question with me. It was not cost: it was durability.

Mr. JENNINGS. How do you put it on? You have spoken about tin: how do you make the gravelled roof?

This matter of gravelled roofs, first of all, I take to be one of great importance. I would take the highest brand of felt, "Beehive brand." I would take the New England cement; and, as I have put it on several mills where I have been on the building committee, I will say it is absolutely necessary to have seasoned plank. I then take Manila paper, and spread it over the entire surface: this is done to keep the tar from penetrating, and reaching the plank, and separating it by shrinkage, — that we may avoid any thing that shall rupture the felting. I then lay three layers of this "Beehive brand" of felting, and mop the entire roof. I then lay another layer of felting, and mop it again. I then lay another; then pour on, and gravel. And I think where we have used it, and gone on that way, — which I know is the way Fall River has done with its best mills, — that it is the cheapest way in the end. I would like to have some one tell me where to find a better way. I have usually made it a point to look after this when constructing a building, to see that it was properly done.

I have had an experience in the Merchants' Mill, and with the Old Colony Railroad, where we have had acres of this same felting and roofing put on. I can look back to 1860, when several roofs of that kind were put on. In regard to the price, I will say that some of it is done very cheaply indeed. I saw a contractor the other day who had a contract for it for some sheds. I asked him what he paid for roofing. He said, "One and seven-eighths cents per foot," *i.e.*, with three thicknesses of

felting. A tin roof would cost from eight dollars to eight dollars and a half per square. When you compare this with a gravelled roof, which can be properly done at four dollars a square, I don't see how you can provide your roofing, using tin, so near the salt water as we are, as cheaply as you can by using gravel.

Mr. BIRKENHEAD. The gentleman suggests the idea whether it is best to put an air-tight roof on over a dressing-room, or whether it would not rot the timbers underneath.

Mr. JENNINGS. We always have ventilators in the roof to take care of that.

Mr. GARSED. One point further in answer to my friend Mr. Lockwood. He seems to think it necessary to make the best roof irrespective of cost. Now, why not put on a copper one? In Philadelphia, I think, thirty years ago they uncovered some roofs put on by Stephen Girard. I saw some of the timbers: they were oak. A coating of varnish had been put upon those oak timbers, and upon the top a copper roof; and it was asserted — I don't know with how much truth — that they had been on nearly a hundred years. Now, if the element of cost is to be discarded, then surely the copper roof is the one we should adopt.

Mr. LOCKWOOD. Might he not carry it a little further? I am not certain but a gold roof would last a little longer even than copper, — perhaps as many centuries as the other would years. We always understand, in a body like this, that we are talking to and in the hearing of men of common sense: hence you may say, that, in respect to the question of cost, of course there is to be some reasonable limit of application.

Mr. GARSED. Most persons would suppose, from their knowledge of the distinguished men of this country in years past, that Stephen Girard was a sensible man, — a man that accumulated and left at that time some thirty-odd millions of dollars, and established what was at that time probably the very best school on this continent. To say that he was not a sensible man, or that he was wanting in sagacity in respect to economy, in putting on a copper roof upon his building! Why, there was not a more economical man in Philadelphia! I am told by a friend who remembered him that he used to ride in his old gig from his farm to his bank, and that the vehicle had not been painted in twenty years.

Mr. LOCKWOOD. I had not Mr. Girard in my mind when I spoke of common sense.

Mr. ATKINSON. I believe some of the oldest roofs in the world are covered with gold: they are in Moscow. And the combined wisdom of the Legislature of Massachusetts has gilded the dome of the State House.

In regard to this matter of covering roofs, reference has been made to the insurance men. The insurance man referred to by Mr. Goulding was, however, that very Mr. Whiting who advised shingles laid in mortar on a pitched roof. That advice has been given, among others, to some of the most skilful paper manufacturers in Massachusetts, whose establishments are subject to a great deal of inside moisture, and who are greatly liable to condensation of moisture on the inside of their roofs. Those who have adopted the thick plank roof covered with shingles laid in mortar will never use any thing else, so well satisfied are they of its being suitable for the purpose and safe in respect to fire, unless they see fit hereafter to adopt flat roofs in preference to pitched roofs.

In respect to the form of roofs, I suppose there would be no difference of opinion as to the merit of the flat roof compared with the barn roof, — provided the question of the right covering were settled. In respect to slate upon a barn roof, not laid in mortar, the underwriters have every reason to consider it dangerous, when exposed to fires in the neighborhood. The slates are very easily broken by heat; they are very dangerous to the firemen; and, unless laid in mortar, the sparks pass through between them, and it is one of the easiest things possible to set the roof on fire, under the slate, from a fire or the heat of a fire in the neighborhood. They are heavy; they are quick conductors of heat and cold; they are dangerous. The form of the roof on which they are placed is the poorest form, in the judgment of those who have a great deal more experience than I have. My experience has been, to build up one story above a barn roof, put a flat roof on, throw the barn roof out of the windows, and cover the flat roof with tar and gravel properly laid.

In respect to the question of roofs in general, I have within the last year or year and a half followed my usual course of asking questions, and have sent to many of you a circular asking questions in regard to the relative merits, durability, and safety

of the various kinds of materials used. I have received about forty answers, and they indicate about as great a divergence of opinion as has been shown upon this floor to-day. The general tone of all those answers varies somewhat with respect to the use that is to be made of the premises under the roof. Very serious objections have been made to tin roofs where any acid fumes were liable to pass through the cracks of the boards, and rot the tin underneath; and various objections have been raised to the gravel roofs from other standpoints. But on the whole, the testimony is, that, considering economy, safety, and stability, and considering non-conducting properties as to heat and cold, the balance of testimony is very largely in favor of the gravelled roof.

But, when you have settled the point of having a gravelled roof, you come again to the consideration of the question of what kind of a gravelled roof you will put on; and I think that a great many of the objections that have been raised against it are due to the fact, that it has been either a bad kind, or an imperfectly applied kind, of gravelled roof. Still there are some points, in respect to the material to be used in the composition, that do not appear to me, after very considerable investigation, to be yet determined. Whether they can be determined by any thing but time, remains to be seen. It is alleged, on the one side, that the coal-tar products which are used in the composition have changed of late years, in consequence of improvements in the method of manufacturing gas, and that what was a good product for a roofing material some years ago is no longer as good as it was, from the removal of some of its elements, in consequence of the better manufacture of gas; also that in the other manufactures that have been entered into from coal tar, some products have been removed, and some new methods of treatment have obtained. On the other hand, it is alleged that if the Trinidad asphalt is used, there is a tendency to a separation of the asphalt from the petroleum product which is mixed with it, as I understand, to give it elasticity and to prevent its becoming brittle, or for some other good reason.

There are three skilful, able, and upright makers of material for gravelled roofs in this city. There are undoubtedly, or may be, others elsewhere. I think it would be extremely desirable if this Association would call upon the New England Roofing Company, the Warren Chemical Manufacturing Company, and

Mr. Samuel Cabot, jun., to submit to the Board of Government in writing, scientific statements in respect to the mode of preparation and application of the materials that they use for the tar and gravel roofing, such statements to be printed by the Board of Government, if they see fit, after having examined them; and it may happen that investigation of an impartial sort can then be made, — as we have made the investigation in respect to oils, and hose, and other matters, — to determine if possible by scientific analysis what the merits of the respective claimants are. To that end I have prepared a vote as follows: —

Voted, That the three prominent firms or corporations, namely, the New-England Felt Roofing Company, the Warren Chemical Manufacturing Company, and Samuel Cabot, jun., be invited to submit statements in writing in respect to the relative merits of their gravel roofing, subject to publication in the report if the government see fit, together with any other suggestions in respect to roof covering that may be submitted and approved for printing by the government.

There is another subject more important in its relations than this one, if you will bear with me for a moment while I state it. This subject comes before the underwriters more frequently than any other, — in respect to the construction of roofs, — and it is a tender point, as you have heard from me a great many times. The other day one of our members, Mr. Storrs of Dedham, came into the office to see how he could prepare a roof for a low building which he was about to add to his mill, in which he works cotton and wool together, so that he could use that roof as a deck to dry wool upon, if he saw fit. Mr. Whiting, who always has a suggestion of a practical sort to make to meet almost any request that can be made, said to him at once, " Well, why don't you cover it with cotton duck, and paint it, as the steamboat-decks are covered? " In conversation with an old steamboat builder, who built a steamer to navigate the Amazon, and covered the deck with cotton duck, I learned that it had lasted sixteen years under the tread of feet, and had served its purpose well. There is not absolute analogy between the deck of a steamboat and the roof of a mill, because the deck of a steamboat is calked, and tight of itself. Nevertheless Mr. Storrs accepted the suggestion, had a duck roof prepared, and placed it upon his mill; and under the advice of a sailmaker, after it had been laid over the edges, washed it with salt water, so that it would be per-

fectly smooth, and have all the wrinkles taken out, and then he painted it; and there it is.

Now, following out that suggestion, I had expected to have had here some duck, prepared with reference to its being nailed underneath at various points. It seems to be a very suitable suggestion, if narrow flaps are stitched to the duck on the under side at every two or three feet, the duck then rolled with the top side in, each flap nailed as it is unrolled, and perhaps painted on the under side as it is unrolled. It may then be attached by the flaps in such a manner, that even if the roof planks shrink and stretch a little underneath, it will draw on the flap, and not on the main surface of the duck. Whether or not a thick cotton duck cannot be placed on a good roof, painted of such tint as reflects heat most (whatever that may be), and made very durable, I think is a matter worthy of consideration. The cost of the material would be twenty-five cents a pound. Suppose it is a yard to a pound, there would be nine feet for twenty-five cents. Suppose you use an eight-ounce duck, then you have eighteen square feet covered with the material, and it will cost twenty-five cents, which is a fair price, per pound. There are asphalt varnishes which may be used for the first preparation of duck, which are as indestructible as the paraffine varnish. On top of that, mineral paint or shellac paint or any other paint that is desired, can be placed.

I respectfully submit that vote to call for the differences in materials used in the construction of gravelled roofs, and for any other suggestions upon the subject to be submitted to the government. And I respectfully submit these suggestions in regard to duck for roofing. If duck is used, it will be important that all the corners over which it is stretched be rounded, as sharp corners will cut the fibre.

Mr. BARKER. I would suggest that the firms or companies that make a specialty of putting on tin roofs be requested and invited to present their ideas in this connection.

Mr. ATKINSON. I accept that. I have somewhat limited the statement in employing it at first, because the resolve is not directed towards what is the best roof covering, but rather directed to ascertain what is the best kind of gravel roof covering. But the other clause would admit any kind of suggestion that might be made, subject to being printed by the Board of Government if they see fit. Your amendment is not required, as you see by the final clause of the resolve.

Mr. BARKER. But if that motion passes, felt-roof men are not going to recommend tin to this Board. I don't see any thing there, as Mr. Atkinson suggests, referring to tin or applying to tin. We call upon gravel-roof men only.

Mr. ATKINSON. The point of the inquiry was directed to ascertaining what are the precise differences in the materials used for gravel-roofing. That is the intention of the resolve. But in order to cover the other point, any other suggestions, in respect to roof coverings, that may be submitted and approved by the government, may be printed, — which opens the door for them to receive any thing, presented by anybody, and approve what they see fit.

Mr. LOCKWOOD. I would suggest that as you specify "gravelled roofs," and make no allusion to tin roofs, the tin-roofers will not consider themselves as included, and will not come unless you send them a special invitation.

Mr. ATKINSON. I would like to keep this to its point, and then have an additional motion, that any other roofers present their suggestions. I want to get out the exact points in regard to the materials used for gravelled roofing, for that seems to be very important.

[A vote was taken, and the resolve as given above was adopted.]

Mr. ATKINSON. Now I move the following in addition: —

That descriptions of any other kinds of roofing may be submitted to the Board of Government, to be printed at their discretion.

[The foregoing motion was adopted.]

Mr. JENNINGS. My experience has been, that I found duck covering, that had been on sixteen years, in good condition, being thoroughly painted. I think duck of eight to ten ounces is not strong enough; but taking the duck I find by the samples I have, twenty-eight and a half inches wide duck, it would be nearly twice as heavy as duck of ten ounces. In putting that upon the roof, I have lapped two inches, and laid the laps in Brooklyn white lead, and then nailed it three nails to an inch, thoroughly, and then painted it with paint with which I have painted the roof, mixing it very thin at first. I took a farmer's boiler, and heated the paint very hot, and put it on hot. That saturates the duck, so that I am not obliged to paint the back side. Around the piazza, after I had taken the tin off, I used this.

Mr. DRAPER. It seems to me that in a cotton-manufacturers' association like this, this use of cotton duck for roofing must be an exceedingly interesting matter. It will promote their business very materially, as well as give them a good roofing, if they can find out the best way to do it; and I think that inquiry in that direction should be pressed.

A MEMBER. I would make a suggestion on this matter, and that is, that the first coating of the cotton duck, instead of being paint, should be a strong solution of silicate of soda, to make it fireproof, as well as waterproof, and then a slate paint on top.

Mr. STORRS. My experience is very limited in the matter of duck roofing. Its use was suggested by Mr. Whiting of the Boston Manufacturers' Mutual Fire Insurance Company. After investigating the matter, and talking with a sailmaker, I concluded to use it. Mr. Atkinson has referred to the duck on a steamboat-deck, which was sixteen years in use. I was referred to one on a steamboat-deck that has been in constant use for eighteen years, and is still in good condition. I have made quite extensive inquiries of sailmakers as to the natural life of a sail; which I find to be four years, with all the action of winds, rains, and mildews upon it. Then it becomes a little tender, and is taken off, and can then be used for roofing and floor-covers. I am satisfied that it is one of the cheapest coverings, and among the best that are known at the present time; although our experience is limited. It can be walked over on a roof, the same as on a steamboat-deck, for aught I can see; and the cost is about the same, or a little more, than a good, thoroughly-made gravel roof. If I were going to build another mill to-day, I should try it; and I should put it on my house. As the gentleman refers to his piazza, I can say the rattle and noise of tin on a piazza is very uncomfortable, — it certainly is around my house, — and the tin is very short-lived. The cover for my roof was made the same as you would make a sail, lapped one to one and a quarter inches, sewed on each side, — all made and brought to the mill in one piece, forty-two by sixty feet. Two men put it on in about five hours. There is no nailing except at the edges and on the ends, — one-inch copper tacks; face-boards put on afterwards. At the suggestion of the sailmaker, I washed it over with salt water, and made it as smooth as slate, and then painted it with slate paint.

The CHAIRMAN. Is there any thing further to be said upon the matter of roofing? If not, the Chair would ask a few moments' indulgence in regard to roofs. At the last meeting of the Board of Government, the matter of constructing and covering roofs was talked over, and it was suggested that some of those present should give their experience in the matter of roofing; and I, as one of the gentlemen present, can give my experience, although not a very profitable one in a financial point of view. As you are well aware, the Social Manufacturing Company's mill was burned on the first day of July, 1874, and rebuilt again the same year. It was built under contract. It was to be built in ninety days, I think, from the time the foundation was put in; which condition, I think, was fulfilled. In the contract the roof was to be covered with gravel; but the company saw fit to change its mind, and adopted a covering of asbestos, which was said to be much better, for the reason that it was lighter, more durable, and was almost indestructible by fire: you could not set it on fire,—that was the argument. The roof was constructed as follows, viz.: the rafters were hard pine, eight inches by twelve inches, and placed eight feet from centre to centre; covering used, two-inch spruce plank, planed one side and matched, pretty dry. Then asbestos was put on in sheets, thirty-six inches wide, and forty feet long. It was laid late in the month of November, the weather cold and snowy. It was difficult to get this material laid on perfectly smooth; and the sheets were put on and lapped, running the long way of the roof, and lapped about three inches, and the joints cemented with a sort of liquid they called asbestos: I supposed it was tar or pitch, or something of that nature. It was put on by A. S. Glover & Co., of Providence, R.I. We got along during the winter very well; but it commenced to leak the next summer, and it has leaked every season: I think the second season it was put on it leaked. We commenced to repair it, and I think since it was put on we have expended $2,200 or $2,300 upon it: the stuff originally cost $2,600. I think if that roof had been three-inch plank, thoroughly seasoned, the result would have been entirely different. Then there was another thing about this plank that was put on, which, as I said in the first place, was contract work,—almost all of it. You know what we get when we contract for matters of that kind; and there were many of the

plank that were not properly secured. The result was warping up and breaking of the joints. And consequently, as I say, we have expended already, since 1874, about $2,300 in repairs. I will say, as regards the asbestos men, that the roof still leaks. Now, if I were going to put a roof on, without regard to expense, I should put on a frame roof, — a pitch roof, — and shingle it. There would be a question if I should put mortar under the shingles. If it takes fire, your building is going to burn before it gets through the shingles in that way. The gravelled roofs are very cheap roofs. If I were going to construct a mill, I should put on a frame roof of good seasoned plank, lay a coat of mortar, and shingle it, and have a roof that would last thirty or forty years. That is all I have to say in the matter. My experience with asbestos has been rather an unprofitable one.

The CHAIRMAN. Shall Mr. Barker's report be adopted?

Mr. ATKINSON. I should have to oppose the adoption of the report. It is a paper submitted, which is gratefully received as to the paper itself, but not to be inconsiderately indorsed by the Association as to what is said in it. I move that it be printed in the Report in the usual way.

The motion was adopted.

HEATING OF MILLS BY OVERHEAD PIPES.

The CHAIRMAN. The next article on the programme is the subject of THE HEATING OF MILLS BY OVERHEAD PIPES, by Mr. GRINNELL of Providence.

Mr. GRINNELL. I feel quite an embarrassment, gentlemen, in appearing before you, even at a request which has been made that I should do so, to speak upon this subject of steam heating; and I have prepared no paper upon the subject for you either to accept and print, or to reject. My office in this matter I feel to be simply that of introducing the subject to your attention, not to ventilate my own ideas; for I feel a certain pressure on me from the brains of other men here present who have had years of experience in this matter of the steam heating of mills. I am in that business, it is true: but I make it a point to serve my customers and my patrons by getting experience from those with whom I come in contact, and not to set up any theories or plans or speculations of my own; and if I am of any value in the community in that direction, it is because I have the

opportunity to obtain from you all, or all who are willing to let me confer with you, valuable experience, and I don't know who it was that suggested that I should bring this matter up. I am simply a passenger here, to bring to your attention a matter which seems to have been considered by some one a question of importance; and I can serve you no better than to state the condition of this matter, as it stands to-day.

Two years ago Mr. William B. Whiting considered the plan of overhead steam heating, as compared with pipes around the room in the ordinary manner, to be far better from the underwriters' standpoint; and he wrote a paper which appeared in your publication of April, 1878, which sets forth those advantages, from the underwriters' standpoint, very clearly. He gives you examples of this method of steam heating which has been tried probably by some of the gentlemen here.

Although not a special advocate of this system in all cases, I have to say that in half a dozen instances that I have investigated, and in three or four instances named by Mr. Whiting, where this system has been resorted to, the men who have it in practical use to-day would not change it. They are perfectly satisfied with it. At the request of Mr. Lockwood, who is now constructing a building which has some exceptional conditions connected with it, I visited the establishment of the Cheney Brothers, to learn, personally, their experience, and found that they are better satisfied with it in every respect than they are with the system of pipes around the room. The concerns which we have fitted up, and where entire satisfaction has been given, are the Ansonia Clock Company, who have recently put up a large new building in Brooklyn; James Legg and Company, woollen manufacturers; the Stanley Works, the Carpenter Steel Mill, of B. B. & R. Knight, Providence, R. I. The Rock Manufacturing Company of Rockville, the Oswego Manufacturing Company of Oswego, Cheney Brothers of South Manchester, and Henry Einstein of Bound Brook, N.J., all use and approve of overhead heating.

I wish to say one word in reference to the wording of the notice in your circular. It seems to imply that something new is to be said upon this subject, or that the plan of overhead steam heating is new. Now, that plan was in vogue twenty years ago almost universally; but it gave a great deal of trouble, on account of the kind of pipes used. These were

large cast-iron pipes, and expansion and contraction caused the joints to leak, and water continually falling from overhead was a great nuisance in almost any manufacturing establishment. Perhaps that, as much as any other one reason, led to bringing the pipes down to a lower level. Then the wrought-iron pipe manufacture improved, and facilities for working the wrought-iron pipe were better; and the plan of small pipes around the room was adopted, as neater, and more readily changed and repaired. So that it seems to me that the change was made from overhead heating to that of circulations around the room, not from any error in the principle of overhead heating, or any trouble from excessive heat overhead, but for the reason that the material at hand then, namely, the large cast-iron pipe, was such as to render it impracticable to make that work tight.

Now, the question arises in every man's mind here, "Can you heat a room as uniformly with the pipes placed overhead as you can with the pipes placed under the windows, where a current of heated air is to rise past the windows, and heat the cold air passing in? In other words, if you put pipes in overhead, will not the floor be cold, and the overhead portion of the room perhaps oppressive?" The best answer to that query is certainly the fact that you can go into these buildings, as I have done, and find the help perfectly satisfied; and learn by actual test that there is not much difference in the temperature overhead and at the floor, under these conditions, from what you would find if the mill were heated at the sides. Of course we know that a mill is always very much hotter at the ceiling than at the floor; but the difference in temperature is found to be but little more, if any, with the overhead pipes than with the pipes on the floor. Just as soon as you warm one portion of the room more than another, the air is set in motion, and by that motion the heat becomes equalized throughout the room, whether you place your pipes overhead or near the floor. Of course many of you may differ from me in reference to this matter; but if it is a fact that the plan is acceptable to those who have tried it, I think I am justified in inviting your attention to it.

I suppose I was asked to bring this matter up in order that manufacturers might consider it, and it might elicit new information, and lead to the adoption of a plan better than the present one. The manner in which this work has been done is

to place the pipes horizontally, lengthwise of the room, turning the corners, to allow for expansion of the pipes, and to take up the difference of expansion on the different lines of pipe in the same coil, and suspend them from the ceiling, not too near to it. The Cheney Brothers have placed the pipes between three and four feet below the ceiling, in a room fourteen feet high. I imagine that has much to do with the success of the plan in that establishment. I would not place the pipes within six or eight inches of the ceiling. It would be superfluous for me to enter into the matter of the practical details of the connecting pipes which supply steam to the circulations. I prefer to carry the main steam pipe in a mill to the upper story, and branch off to the places where I wish to come down, and attach the circulations to these return pipes.

I will here leave the matter for discussion, and not further ventilate my own views or opinions.

Mr. DRAPER. I think if those who work in the mills were all bald-headed, like myself, they would not want any thing above their heads radiating heat directly down upon them. They would prefer to have the heat come from the side of the room. I have in mind a case exactly in point. I board at a hotel in the city a few weeks in the winter; and every time I go into the barber's shop, it is so arranged that they have a radiator right on a level with my head, and I feel very much as though there was something wrong every time I go in there. It certainly is exceedingly uncomfortable. You cannot get out of the line of the direct radiation of heat. The most intense heat comes to you in a direct line from the point where it starts. If you put that apparatus over your head, the heat must radiate directly down. I am satisfied that a bald-headed gentleman going into a room excessively warmed would be annoyed by it. If you put the pipes around near the floor, or near the outside of the room, I think they would be far more likely to generate these currents, because the cold air comes in more or less around the windows, even when there are double windows, and around at the doors, and does not come in, as a rule, overhead; so that I think the philosophy of putting these pipes overhead, as regards adding to the comfort and the health of the people employed, is just in the wrong direction.

Mr. GRINNELL. I would like to hear from Mr. Thomas Pray, jun., on this subject; for he has been through with this

process of changing the pipes from the one location to the other.

Mr. PRAY. So far as the matter of direct radiation goes, I think there is nobody here but knows that radiation, as a matter of radiation, is direct. But all radiation is commenced by the currents of air; and, as Mr. Grinnell has stated, very properly, any disturbance in any part of the room immediately sets all the air in that room in motion. That I have proved. In 1871 I owned a narrow, old-fashioned mill, and was trying to get six thousand spindles in, where there had been but three thousand. The matter of room was a matter of a good deal of consequence. The mill was thirty-eight feet wide inside, by one hundred feet long. I put in Mason looms there, and there was not much room for outside matters. The heating bothered me a good deal. The air came in at the windows, and went round in the old-fashioned plan. The pipes were always covered with waste and grease, and everybody was apt to get more or less slush on them. Finally I took the whole matter down on the floor. We had in the mean time kept track of the fuel we had used for two winters, and knew where we were coming out. We then ran the circulation overhead, dropping it down under the beams with wrought-iron clips, five-sixteenths inch iron. It was put up in the summer. Along in the fall, the help began to get uneasy. Finally we had one or two cold snaps, and steam was put upon the mill, and everybody, to my surprise, found he was all right. It went along to about Thanksgiving time, when we had snapping cold weather for a week, and my superintendent was making some changes in the mill. I had taken off the belt while running, and broke a light pulley, which stopped all the machinery in the room. The men had to sit on the floor, and do the work for four or five days, and part of the work was done nights, to hurry along. The question came up, whether the shafting was going to circulate the air, or whether the pipes were. The agent went to work, and hung three thermometers at different places in the room, one halfway from the beams, and another a foot from the ceiling. To my astonishment and his, we found the temperature of the room, when the doors and windows were shut, was a little less than four degrees more at the top than at the middle. There was a variation of only eight degrees between the top and the bottom. This was in the lower room of the mill. Now, we

had one of these flat plank-covered roofs on the mill, and four mules working, and the piping overhead. Then we went into the filling-mills for the same purpose. He took the shafting all down, so as to level it up, and stopped all the belting in the room. It took them a week to take care of the filling mules. We demonstrated the thing clearly, that direct radiation, and not the belting, did the heating. The men worked with comfort night and day. That was followed up for about two years. We finally compared notes on the amount of fuel used, and we found a difference of from ten to fifteen per cent. The mill was heated better than ever, since or before. Since then, we have been trying the experiment in a small room, of the admission of air over the tops of the windows. I have just finished the plan of a building sixty feet long and eighty-four feet wide, which is to be heated on this system. I shall put over the windows a cast-iron arrangement for allowing the cold air to come in upon the steam-pipes. We have found the temperature in this way much more equable than I have ever seen it in any other establishment, by actual demonstration with a thermometer. If any man wishes to follow the lead of the Cheneys of South Manchester, he can do so. I would not consider a mill first-class, that had the old-fashioned heating arrangement. Practically, the new system is better. It is more economical. It is already settled, that it will cost you less to put up the pipes. If those are not practical considerations, I don't know where you will find them.

Mr. ATKINSON. From my observation, I don't think this is any longer an open question. Whenever the suggestion has been made by any one of our inspectors to alter the pipes in a crowded room in a mill, and it has been done in order to clear the pipe, within a year every pipe in that concern has been moved up overhead, because of the benefit that appeared in the first room treated. I don't think it is any longer an open question. It is said that heat rises; and, so far as that means any thing, it is equally true that cold falls. But it will be found that, whatever heat is, it distributes itself according to the condition of the atmosphere, and that its distribution depends a good deal upon humidity, as well as upon other causes.

Now, knowing that this subject was coming up, I asked Mr. N. M. Lowe to come here, and bring with him the apparently little toys which are in the windows [referring to peculiar ar-

rangements of sets of paper windmills placed in the windows of the room], as instruments to show you the convection of heat. Those are being operated now by the movement of the atmosphere of this room. These are not conditions suitable to show the real workings of those instruments; but if any gentleman wishes to know exactly how the atmosphere of his room is being distributed, and how the heat is being distributed through the room, a few of these little instruments, placed here and there, will quickly show him. I imagine that under those circumstances our friend Draper would not be so much afraid of his bald head. The last case of dread of any change, that I heard of, was in regard to a very experienced weaver in the Tremont and Suffolk Mills. Mr. Garland's atomizer was being placed there; and she left the premises, and went up to Nashua, and went into the Jackson Mill, and said she would come there because that atomizer gave her the rheumatism, it made the air so damp. The only trouble about it was that the atomizer had not been started. I think that Mr. Draper will not find that heat distributed from above affects his head so unpleasantly as heat distributed from the ordinary point.

Mr. JAMES W. CUMNOCK. Are these pipes located in the centre of the room, or on the side? In what position are they located?

Mr. GRINNELL. In thinking this matter over, I have come to the conclusion that it is quite important where these pipes are placed; and I should not recommend, from my own judgment, placing them too near the side of the room. I believe that too much importance is attached to the fact that cold air is coming in at the windows. In a building that Mr. Lockwood had spoken to me about, and that we had thought over, — a building about one hundred feet wide, — I had proposed to put these pipes some eighteen or twenty feet from the sides, and in this case down some three feet below the ceiling. If I can make a sketch here so as to represent about the proportions of that mill, I think it would be a little instructive.

Mr. J. W. CUMNOCK. If those pipes are put in the centre of the mill, running lengthwise, I must go over them, through them, or under them with the belting. Every one knows that when belting goes under a pipe, if it strikes it, it is apt to make it leak. If you run six or eight lines of pipe through a mill, and then belt over it, as you would have to do by this system, I think you will find it impracticable.

Mr. DRAPER. I think all of us must have ridden in a railroad car, where the pipes were put around the bottom, and put our feet upon them, and found a very decided difference in the condition of our feet, and the condition of our heads, from what is the case when we ride in a car which is heated with stoves, where the heat goes up, and the floor remains cold. If that is not an illustration of a room in a mill, I am very much mistaken. Now, in regard to that windmill arrangement in the windows, if that exemplifies any thing, it exemplifies just what I said. The air is coming in from out of doors, and carries those fans around, just as in the case of any windmill. You can see by going there how it is done.

Mr. ATKINSON. I said to Mr. Draper that the conditions under which that was operating now were not suitable. It was placed there just for experiment. *There is no patent on that.* [Laughter.]

Mr. GRINNELL. I have pressed myself before you a little at this juncture because I wish to follow up Mr. Cumnock. I have been too long an expert in this matter to undertake to straddle a lot of steam-pipes with a series of belts. That is one of the practical details which must be carefully guarded against. And I must appeal to Mr. Lockwood again, by calling his attention to the fact, that in placing the pipes in his mill, which is about one hundred feet wide, I did most carefully plan and guard against that trouble; and, placing those pipes in that particular position in that mill, we escape all the cross-belts.

Mr. CUMNOCK. In the mills I mentioned, where I am agent, the machinery has been altered over five or six times. If the gentleman put up his pipes the first time, they might not be right five or six years hence, and consequently they would all be taken out. We are continually adding and taking down. Just the minute a belt strikes a pipe, it goes down.

Mr. PRAY. I have been among mills for the last twenty years. I never found a man who put shafting within four or five feet of the side of a room as a general thing. If he changes that, can't he just as well change the steam-pipe, at very little expense, to accommodate the shafting? In a majority of our mills I can put up steam-pipes everywhere, where it can be free from any objection stated here to-day, and do work with very much less objection.

Mr. J. W. CUMNOCK. My men put up pipe more quickly on

the wall than they can on the ceiling. So far as the piping goes, it is entirely out of place for me. If you are using eight-inch or ten-inch drop-hangers under your beams, you must come in contact with your belts. In your lower weaving-room, your belts are very thick. I asked the question whether the pipes went near the corners of the room, or in the centre. He puts it eighteen feet from the side; consequently that comes directly in the way of the belts. It makes a great deal of difference about pulling down belts, and overhauling them. If you have a little mill, you can do it very well, and pipe it; but if it is two hundred or three hundred feet long you cannot pipe it every day.

Mr. PRAY. This mill that I am speaking of is three hundred and sixty feet long, and eighty feet wide. I believe there is a mill something like nine hundred and eighty feet long that is piped in the same way.

Mr. LOCKWOOD. In this connection I would say that we are now building a large weaving-shed four hundred and fifty feet long, and ninety-odd wide. This question came up for consideration; and certain local conditions existed that made it very desirable to heat overhead. Knowing that some had done it, I gave the matter some consideration. I have generally found in life, that where there is a will there is a way. This matter of belts, and shaftings, and all these local conditions, are important, in my case. It would not have been so in all cases probably. The method of placing the pipes was such that there was no interference with the belts. But that was not my main object in rising. When this question of heating came before the committee, we were rather hard pushed for subjects to bring before this meeting to interest you and take up the time. This was presented, and occurred to us as a subject that might interest some, and if we were short of subjects this would fill up the time; but having accomplished that, and filled up the time, it seems quite enough in that way. I move that the subject be laid on the table.

Mr. J. W. CUMNOCK. When the pipes are running lengthwise of the mill, and the belts at right angles, how are we going to escape the pipes? I should be glad to see it in that way; but I want information.

Mr. ATKINSON. I suppose there have been greater changes in the works of the Cheney Brothers (I am informed so), from

changes in the business itself, than ever could possibly be in any cotton-mills. They are heated by overhead pipes, and they have adjusted themselves to all these changing conditions without any difficulty; and Mr. Leigh says all the mills in England are heated in that way. I think the Oswego Manufacturing Company has a twenty-set mill; and for a woollen-mill, it is as difficult of adjustment as a cotton-mill. After they had been advised to change one room under special conditions, they changed every part of the mill; and Mr. Trainor has done the same thing. I think Mr. Cumnock, by changing some part of his mill, will find all his difficulties removed.

Mr. CUMNOCK. If I run my pipes lengthwise, and my belts crosswise, how am I going to escape the difficulty?

Mr. MCARTHUR. Before this subject is disposed of, I wish to add a few words of my own practical experience. In the top room or attic of one of our mills, we had a great deal of trouble to keep it warm during the winter months. I had the steam pipes taken down from the ordinary way of running them, and placed them up overhead. This change was made some four years ago; and since that time we have had no trouble to heat the room; which has led me to believe that overhead piping is the proper way to heat mills.

Mr. ATKINSON. Pending the motion to lay the subject on the table, I would state (it being now lunch-time) that if there is time this afternoon, and a wish on the part of the members of the Association, the history of further experiments on oil will be given by Mr. Woodbury, and results reached will be stated, that have never been reached before in measuring the co-efficient of friction. We have a machine which is an absolute measure, and will determine every time the co-efficient of friction of every lubricant under friction. There are also one or two other things for your consideration, which will be presented this afternoon.

Mr. WEBBER. At the suggestion of several members who are too modest to mention it themselves, I move that the Board of Government be requested to prepare for the next meeting some discussion which shall bear directly on the details of cotton manufacturing. And it has been suggested to me, that since picking and carding have been discussed here, there have been some improvements made which would make those very proper subjects to come before us, and that the Board of Gov-

ernment be requested to make such arrangements as to introduce for our consideration any improvements that have been made in picking and carding for three or four years. I wish to say that the last two or three meetings have been very interesting, especially so to me, more particularly as an engineer than as a manufacturer. But gentlemen who have spoken to me have said that we seem to have departed from the subject of cotton manufacturing very largely, and therefore request me to make this motion.

The motion to lay on the table the subject of the heating of mills was adopted.

Mr. DAVIS. There is a matter which ought to come before the meeting, which is very important, — the financial matter. We have not passed any vote authorizing the Board of Government to assess members yet. I offer the following: —

Voted, That the Board of Government be, and they hereby are, authorized to lay such assessment upon the members of the Association, as in their opinion is required, to meet the expenses of the coming year; such assessment not to exceed in amount ten dollars, as limited by the by-laws.

The motion was adopted.

Mr. WEBBER. I now renew my motion, —

That the Board of Government be requested to prepare for the next meeting some subjects for discussion relating to the details of cotton manufacturing, suggesting picking and carding as a suitable subject.

The motion was adopted.

[Recess till two o'clock P.M.]

AFTERNOON SESSION.

The Association re-assembled at two o'clock P.M.; the vice-president, Mr. NOURSE, in the Chair.

Mr. ATKINSON. If there is no other subject before the Association, while the members are gathering I will speak of one or two points that it may be desirable to have go into the report, mentioning them simply, rather than presenting them for discussion.

In the first place, gentlemen may be interested to see samples of the kinds of yarn that are being now made at Lowell in North Carolina, brought here by Mr. Dumont, who has been present with us to-day. He will show you how well North Carolina can compete in respect to the manufacture of yarn. The samples are all, I think, ticketed, and will show for themselves what they are. Mr. Dumont is here, or will be here, if any gentlemen would like to ask him any questions by and by.

Now, as to one or two points that have been brought forward for information at previous meetings: I called your attention some little time ago to a new kind of paint that kept perfectly white under the most adverse conditions of acids or gases or any other obnoxious influences. It has been tried by Mr. Moses Peirce in the Norwich Bleachery very thoroughly, under the most adverse conditions, and keeps perfectly white. It is the Griffiths silicate white.

I would say again that we have no interest in these matters, except to give you the information. I don't even know the parties, have not even seen them. But there is a paint, the silicate white, that keeps white under the most adverse conditions.

Mr. GARSED. Is it different from the zinc white?

Mr. ATKINSON. Yes, sir: it is an entirely new thing; has been adopted by the British navy and the American navy for the protection of iron ships, and is really worth knowing about.

There is a skylight on the little building next to this that has been made to meet the conditions of one-story buildings or of the upper rooms of mills, with reference to cheapness and to the right direction of the light, as a substitute for the ordinary monitor, and with reference to easy ventilation.

In connection with the subject of the packing and handling of cotton, and the "bale of the future," which has been brought before you, a favorite subject of mine is now being thoroughly investigated through the census department, and that is the subject of the production of wool and cotton from the same field. Information received from Arkansas, where sheep have been fed upon whole cotton-seed, fed before the oil is taken away from it, as it should be, proves that diseased sheep become healthy on a limited feed of cotton-seed; and that if you are treating land that produces a bale of cotton to the acre, you will have with that bale of cotton enough feed to carry five sheep through a winter season of a hundred days on the adjoining acre, with no other feed than the seed of that lot of cotton and the grass that follows the cotton. And the principal informant told me that, being poor, he bought a lot of diseased sheep, and they became healthy in the first season. He had from the original flock one more lamb than he had ewes; and in the next season he had seventy-five per cent of twin lambs. I imagine that cotton-seed mutton would not be as desirable as cotton-seed wool. It is an important subject; and I venture to predict that within a comparatively short period the great source of fine clothing wools will be from the upland cotton district, from sheep fed upon the seed of cotton, and upon the grass that follows the cotton.

The great enemy of the sheep in the Southern States has been the dog. The dog owns the State. In North Carolina, after various attempts at improvement, an arrangement was made to kill a dog, and carry the case up to the Supreme Court of the State; and a decision was obtained adverse to dogs, and they are now *feræ naturæ*. In other States the decision does not prevail. But the Washburn & Moen Manufacturing Company have so perfected their barb-fence that at an expense of not exceeding a dollar a rod a five-row dog-proof fence can be put around any plantation. A thousand dollars will protect four hundred acres, around the outside, and criss-cross into four fields, to be cultivated in rotation; and you will bear in mind that ere long you will get double the cotton-crop from the fields from the sheep-manure, and you will add to it the wool-crop. That is a rash prediction perhaps, but you may keep it in mind.

The strength of timbers and of posts is a subject that needs attention. The proportion of large hard pine timber that can be reached, near to the rivers and railroads, from which large factory beams of 7 × 14 or 6 × 12 can be made, is becoming limited. Ere long it will be difficult to get your solid beams. It appears that a composite beam of iron and of wood is not approved by the engineers, if flat surfaces of iron are used, or if the T-form or H-form is used in combination with wood, for the reason that the strain pulls either upon the wood or the iron, and not upon both at the same time. But it further appears that the strongest column that can be made, and the most durable, is by taking, we will say, a six-inch wrought-iron pipe, and putting into that a five-inch wooden core, and filling in between with plaster of Paris: such a post will bear a greater strain, and will not break except at a white heat. There have been some experiments, but I think none of an exhaustive character, upon that point; and if the directors will allow me, I propose to test the strength of columns thus made. It further appears, that in respect to iron the strongest form for a beam is a tube; that that tube is subject to being bent and to great vibration if nothing but iron is used; but if into the interior of the tube a tight-fitting wooden core is inserted, that you then get all the strength of iron, without any great tendency to vibration, and that you cannot bend that composite structure. You may break it; but the moment you begin to bend it, there comes up a friction between the wood and the iron laterally that prevents its bending until it reaches almost the breaking point. It has therefore occurred to us that a beam might be constructed, of which that illustration before you is a magnified copy, the blue representing an iron tube, the centre having a wooden core with a hole left for ventilation at the ends, then a coating of plaster of Paris on the outside, and then two pieces of timber of proper sizes to form the exterior. And it is perhaps within the bounds of probability that that may prove to be a composite beam of great strength, and that we may in the course of the next summer procure the necessary apparatus to test the formation of that beam. It is theory, and is suggested as theoretic matter. There is reason to believe that it is right.

Two or three other things I will call your attention to, if you

will permit me. This gear which is upon the platform, I think you may be curious to see. It has a roller-bearing, and weighs some four hundred pounds, and an ounce weight upon the tooth operates it, or it can be operated at a distance from the shaft with No. 12 spool cotton; no oil being required, but oil if put on being an injury. It is the invention of John G. Avery of East Brookfield, who I am told has also devised an exceedingly cheap and ingenious method of hardening iron for axles. This requires very hard metal. There is a roller, corresponding to the one in the case, which has run ten thousand miles upon a freight-car. A horse-car has been running on the Tremont-street line for many months, with these roller bearings, without any lubrication. It certainly opens a field for investigation. The axle has been applied to buggies and other vehicles; and here is an axle of Mr. Avery's make which shows the whole method by which it is to be worked. I say again, that of course I have no interest in bringing this before you, except to call your attention to it as a thing possible to be placed where you have very heavy bearings liable to heat. It is a thing to be thought of and investigated, in connection with future construction.

You are aware that we tried, on behalf of the Manufacturers' Insurance Company, a large number of samples of hose; and we have sent to each agent and treasurer the first report of the trials of the hose. Duplicate pieces of each kind tried have been placed in the Waltham Bleachery, where they were alternately exposed to dampness, heat, and dry cold. Here they are, well mildewed many of them, and others apparently well protected by paraffine wax. A final trial of these pieces is to be had; and then the whole hose question, so far as the examination goes, will be complete. I suggest that it is a matter that might well be put upon permanent record, and I offer this vote: —

That it be left to the discretion of the Board of Government to print in their report the whole of the hose trials, if they see fit.

[An amendment was moved, and accepted by Mr. Atkinson, that the report of the hose trials shall be published in the report of the proceedings of the meeting; and the motion as amended was adopted.]

Mr. ATKINSON. There are one or two other little things that I wish to refer to, and then I will not take up your time any longer. This loom was placed in our office by a friend of our Mr. Sherman; and it attracted my attention at once, and I brought it here for you to see, — the shuttle-motion being the point to be investigated.

A sample of the shafting that has been tested at Watertown Arsenal has been sent in to me, with the request to present it; and it will come up in connection with an invitation to you from Mr. Howard to visit Watertown to-morrow, and that example of shafting that has been tested is therefore presented by me at the present time.

Mr. Lenox is present, and represents the wire tie, on this bale of cotton, which is compressed either to thirty or thirty-five pounds per square foot. He presents to you these circulars, so far as they will go, showing what will be saved both to the manufacturer and to the planter; and Mr. Lenox will be glad to speak to you, if you feel disposed to hear him, by and by, when that subject again comes up.

One word more in regard to the subject of roofs. I think an injustice may be done to the gravel roofing, as a roofing material, unless Mr. Barker is called upon to explain the mode of construction of the wooden part of his roof. I understand that that roof was not a solid plank roof, but that it consisted of two thicknesses of inch boards, with about an inch space between them, with apertures left in the lower board, or the board upon the under side, with a view to promoting the circulation of air between the two sections of the roof, and that it was over rather a damp place.

Mr. BARKER. Not specially so. It was over a woollen mill.

Mr. ATKINSON. Now, I should hold, from what observation and experience I have had in the matter, that it mattered very little whether a roof of that construction was covered with copper, wood, or tin. That wood-work was bound to rot out in a short time, whatever the material was, for the reason that the air space between the two thicknesses of board is not sufficient to permit the circulation of the outside air, and that there

will be a rapid condensation upon the under side of the outer board. In all such situations you will invariably find, that, instead of a circulation of air, you will have a circulation of gases or water, condensing on the under side of the outer board, and dropping from that upon the upper side of the inner board, and both will rot out in very short order, whether you cover with copper, tin, or any material. The fault of that roof, therefore, should not be attributed to the outer covering, but to the construction of the roof itself. I want to put in that explanation, lest an injustice should be done to gravelled roofing.

THE CHAIRMAN. As Mr. Howard of the Watertown Arsenal seems not to be present to give us his explanations in regard to the matter of shafting, we will now hear from Mr. Lenox in regard to the wire tie.

Mr. LENOX. I don't know that I can say a great deal that is absolutely new to you regarding the bands in use for binding cotton. You are all acquainted with the superfluous amount of metal that is used to-day. But an effort has been, and is now being made, to introduce wire as a substitute for the heavy flat bands so commonly used; and a steel wire tie of the most efficient kind is at this time being made. Several thousand tons of wire ties are now being sold annually in this country; and on this bale of cotton which has been presented here will be found some steel wire ties. Ties of this kind are in use, binding cotton that is compressed to a density of thirty-five to forty pounds to the cubic foot. You will therefore judge that in respect to strength a wire tie is equal in efficiency to a flat band.

The weight of the flat ties in use to-day is some twelve pounds to the bale of cotton, when the same bale may be bound with equal efficiency with wire bands weighing but three pounds.

Circulars relating particularly to the kind of wire alluded to will be mailed to the members of the Association.

There has been great difficulty in introducing the use of wire among planters South, from this fact: that they pay some six cents per pound for the flat hoops, and sell them at the price of cotton, ten to twelve cents per pound, and thus make one hundred per cent profit by the transaction. The parties engaged in importing and manufacturing flat bands annually

issue circulars pointing out this advantage of the use of heavy hoops. Now, as I say, an effort is being made to introduce wire bands; but of course it is found a pretty difficult thing to do in view of the large supposed profit made by the use of the flat tie.

The question arises, as has been said by the Washburn and Moen Manufacturing Company of Worcester, Mass., in a circular relating to this subject, whether it is not now the time for buyers of cotton to advertise that they will pay more for wire-bound cotton than they will for cotton bound with flat hoops. It can be demonstrated that the buyer can pay an extra price for wire-bound cotton, sufficient to compensate the planter for using wire, and still leave the former a profit. It can be shown that the planter at present prices is profiting to the extent of sixty-eight cents per bale by the use of flat bands. If he uses the wire tie, equally efficient and costing one-half less, his profit from the sale of the metal is some twenty cents. The difference to the planter in favor of the use of the flat band is about fifty cents per bale. Now, the loss to the consumer from using cotton bound with flat bands is some one dollar and forty-five cents per bale; but his loss in using wire-bound cotton is only sixty-two cents, — difference eighty-three cents.

By paying one-eighth of a cent extra for wire-bound cotton, or fifty-seven and a half cents per bale of four hundred and sixty pounds, the planter will be indemnified for any present supposed loss he may sustain by using wire, and the manufacturer will gain some twenty-five cents per bale; amounting in the aggregate to something like a half-million dollars on the present annual consumption in this country.

A MEMBER. What is the method of fastening this wire?

Mr. LENOX. It is fastened by a clasp.

A MEMBER. Does it not require tools to fasten it with?

Mr. LENOX. No, sir. I have letters from a cotton-yard master in Memphis, who states that he thinks his men can fasten the wire tie much more rapidly than they can the flat bands. They are made in various lengths. The band is of double wire, and the clasp has a peculiar construction which renders the tie adjustable in regard to length.

A MEMBER. Is any thing done to the wire to prevent its rusting?

Mr. LENOX. The wire may be galvanized. Those made un-

til now have been galvanized. They may be varnished. This question may arise, — in view of the fact that cotton is so costly in the package, — as to whether the wire is strong enough; whether, for instance, if you use less than one-half the weight of metal used in the case of the flat bands, you will get wire sufficiently strong? The wire ties in question will stand a strain of twelve to fourteen hundred pounds, and the steel of which they are made is much more uniform in respect to strength than any iron.

Mr. DRAPER. Mr. Chairman, I have no desire to throw cold water on this different way of fastening cotton in the bale. I would be glad to see all the saving made that we can make, but I think that this statement is open to a certain fallacy being charged upon it. It will be like one man agreeing to sell his machinery, and charge for boxing, and another man to sell machinery, boxing and all. Now, what people buy principally is the cotton. The planter is charging so much for his cotton with ties included. If he puts on a tie by which he loses money, he must charge so much more for his cotton, and the matter will adjust itself. It is really a matter for the people who have the steel tie, to introduce them themselves. I don't believe there are any practical gentlemen here but what will say at once that the price of cotton is not fixed by what is put upon it, but that it is fixed by the value of cotton in the market.

Mr. ATKINSON. My object in bringing the subject forward in connection with the cotton tare was to get it upon the record, where it will be seen to be a method that will be profitable to both parties. This Association does not give the orders for cotton, and it does not introduce the steel tie; it simply (if this is admitted by the Board of Government to the report) admits a statement of the fact that by an improvement in the weight of the material used, a saving can be made to both parties. If I may be permitted to say so, I, some time ago, saw this material being made in Philadelphia, and thought that it would come into use.

There is a very cheap roving-can called the Leatheroid roving-can, that is worthy of your attention.

I will also state here one other thing, which I omitted, that

will be curious to you. During the process of the investigation of hose, Mr. Cyrus M. Warren, of the Warren Chemical Roofing Company, asked leave to submit two samples of cotton, cloth chemically treated, to fend off mildew, by a process he had lately devised, which he said would be very cheap, but he did not know how effective it would be. I have not yet seen this process; but these two pieces of cloth have been subjected to the same conditions of atmosphere as these two pieces of hose, and the different result is a matter certainly curiously worthy of your attention. They appear to be entirely unimpaired by any mildew, while the untreated hose has been destroyed.

The CHAIRMAN. If there is nothing further to be offered upon this matter, the subject of the oil tests will be next in order.

Mr. WOODBURY. — About a year and half ago Professor Ordway gave to this Association the result of the chemical tests of the lubricating oils used in mills. Those oils were collected by myself on my inspecting duties; and a label was attached to the bottle, which consisted merely of a number, and they were handed over to the chemist for chemical examination. I was instructed to promise to the agents and managers of the mills that for their samples and for all information which they could give in the practical use of the oils, the insurance companies on the other hand would give to them all the information they could get, not only of the oils chemically, in relation to the fire-test and such other tests as investigation might prove necessary, but also the lubricating property: thus entering upon a course which would prove of mutual benefit, both to the insurance companies and the manufacturers. It was no easy matter to fulfil the latter part of the promise; and it is only at this time that we are able to submit the beginning of positive frictional results, as the oil-testing machine which has furnished these results is the tenth one which we have used.

In this report of my work upon the friction of lubricating oils, I shall restrict myself to a description of the apparatus designed especially for the purpose, the method of its use, and the results obtained with a number of oils in our market which are used for lubricating spindles. Previous investigation of nine different oil-testing machines used showed that none of them

could yield consistent duplicate results in furnishing the coefficient of friction. The operation of these machines by their failure to obtain correct results adduced certain negative facts which established positive conditions as indispensable in the construction of a machine capable of measuring the friction of oils. The following circumstances must be known and preserved constant: temperature, velocity, pressure, area of the frictional surfaces, thickness of the film of oil between the surfaces, and the mechanical effect of the friction. In addition to the foregoing conditions, the radiation of the heat generated by friction must be reduced to a minimum, the arrangement of the frictional surfaces must be of such nature that no oil can escape until subjected to attrition. To measure the frictional resistance at the instant of a given temperature, and at a time when both temperature and friction are varying, requires a dynamometer which is instant and automatic in its action. The apparatus consists of an iron frame supporting an upright shaft, surmounted by an annular disk made of hardened steel; upon the steel disk rests one of hard bronze,[1] in the form of a cylindrical box. Water is fed in at one side, and a diaphragm extending nearly across the interior produces a uniform circulation before discharge. Although this use of water is original with the writer in the method of its application, the first use of water to control the temperature of the bearing surfaces of oil-testing machines is due to Monsieur G. Adolph Hirn, and described by him in an essay on the subject of friction, and read before the Société Industrielle de Mulhouse, June 27, 1854.

Mr. Charles N. Waite first called my attention to the use of water in this connection by his method of application in seeking similar results.

A protection of wool batting and flannel to guard the disks against loss of heat by radiation diminishes the escape of heat by conduction and radiation to about one degree per hour, which loss is not appreciable when observations are taken within a few seconds interval. A thin copper tube closed at the lower end, reaching through the cover, extends to the bottom of the disk; the bulb of a thermometer is inserted in this tube, and measures the temperature of the disks; an oil tube runs to the centre of the disk, and a glass tube at the upper end indicates the supply and its rate of consumption, and also serves to main-

[1] Composed of the following alloy: copper, 32 parts; lead, 2 parts; tin, 2 parts; zinc, 1 part.

tain a uniform head of oil fed to the bearing surfaces. The rubbing surfaces of both disks were made to coincide with the standard surface plates in the physical laboratory of the Institute of Technology, and their contact with each other is considered perfect.

The rounded end of the upper shaft fits into a corresponding depression in the top of the upper disk. This method of connection retains the disk over the proper centre, yet it is allowed to sway enough to correct any irregularity of motion caused by imperfection of construction or wear of the lower disk. To obtain the desired condition of pressure, weights are placed directly upon the upper spindle. The axes of the upper and lower spindles do not lie in the same straight line, but are parallel, being about one-eighth of an inch out of line with each other: such construction, giving a discoid motion, prevents the disks from wearing in rings, and assists in the uniform distribution of the oil. An arm is fastened through the lower part of the upper spindle, and engages with projections upon the upper disk. Upon this arm, which is turned to the arc of a circle, whose development is two and one-half feet, a fine brass wire is wrapped upon this arc, and reaches to the dynamometer so that the tension of the dynamometer is tangential, and the leverage is constant for all positions of the upper disk within its range of motion.

The dynamometer is contained within a steam gauge case, and was designed especially for this purpose; the resistance of friction is shown by the pointer upon the dial.

Professor J. M. Ordway designed the framework of this machine, which was constructed by Browne & Sharpe, except the upper disk and the dynamometer.

When completed, the machine was subjected to a long series of tests with the same oil to determine the accuracy of the results, and the best method of procuring them. Concurrent results were obtained under equal circumstances, but the co-efficient of friction varied not merely with the lubricants used, but also with the temperature, pressure, and velocity. The results of my own experiments on mediate friction do not agree with the laws of friction as given in works on mechanics, but the co-efficient of friction varies in an inverse ratio with the pressure. The variation of friction with the temperature is shown graphically on all sheets reporting the friction of each

sample of oil used. A little difference in the sample would cause a difference in the line of curve. Reference is made to Curve D, showing the co-efficient of friction under equal ranges of temperature and velocity, but with a different series of pressures.

CO-EFFICIENT OF FRICTION AT 100 DEGREES AND 500 REVOLUTIONS PER MINUTE.

Pressure per square inch.	Co-efficient of friction.
1 pound	.3818
2 pounds	.2686
3 pounds	.2171
4 pounds	.1849
5 pounds	.1743

It was decided to begin these investigations with spindle oils; and therefore the machine was loaded with five pounds to the square inch, and run at about five hundred revolutions per minute, as the oil under these circumstances is submitted to conditions of attrition corresponding to those met with in the extremes of velocity and pressure in the case of a Sawyer spindle running at 7,200 revolutions per minute. And the results subsequently given refer only to the friction under these conditions, except when expressly stated to the contrary.

The apparatus is used in the following manner to measure the co-efficient of friction of oil: After cleaning with gasoline, and wiping carefully with wash-leather, the disks are oiled, and run for about five hours, being kept cool by a stream of water circulating through the upper disk. From time to time they are taken apart, cleaned, and oiled again. After using any oil, even if the disks are afterwards cleaned, the results with the oil subsequently used give the characteristics of the previous oil; and it is only after from thirty-five to forty-five miles of attrition that these results become consistent with each other, each succeeding result, meantime, approaching the final series. This seems to indicate that the friction exists at the surface of the two disks, between the film of oil acting as a washer, and the particles of oil partially embedded within the pores of the metal. When the disks are ready to test the oil, the apparatus is cooled by the circulation of water, which is stopped when the machine is started. At every degree of temperature, the corresponding resistance is read on the dynamometer. When the thermometer indicates a temperature of sixty degrees, the

counter is thrown in gear, and the time noted. When one hundred and thirty degrees is reached, the counter is thrown out of gear, and the time noted. This not only gives the velocity of the rubbing surfaces, but the number of revolutions required to raise the temperature a stated number of degrees, and is a close criterion of the oil. The co-efficient of friction is the ratio of the pressure to the resistance.

The following table shows the resistance of friction at 100°, 500 revolutions, for various pressures.

Pressure per Square Inch.	Resistance in Pounds on Dynamometer.	Corresponding Band tension.
1 pound	2.62	0 8 pound.
2 pounds	3 68	1.6 pounds.
3 pounds	4 48	2.4 pounds.
4 pounds	5.14	3 2 pounds.
5 pounds	5.98	4.0 pounds.

For further detailed results, reference is made to Curve B.

These results seem to be intimately relevant to the most desirable limit of tension to the spindle-band and methods of operating spinning machinery. By weighing the band tension in various mills, it was found that the practice of tying bands lacked uniformity. As an example of this variation, in one mill the bands of a single coarse frame are reported to vary from one to sixteen pounds; in another mill, on finer work, a number of spindles had a range of from one-half to two and a half pounds; and in a third mill the band tension was between the limits of one-fourth to five pounds. The effect of atmospheric changes upon the fibre of textile bands renders it impossible, with the present method of constructing frames, to keep them at a uniform tension; but this variation can be reduced by a little care.

Is it not worth while for each spinner to learn the proper band tension required for his special work, and then keep within those limits. The whole power required to run the frame would not vary in direct proportion to the varying resistance due to the friction of spindles at various pressures, because the resistance of the friction in other parts of the frame connected with the spindles, the actual spinning of cotton fibres, and the alternate contraction and expansion of the bands, are conditions

which are more nearly constant, and in no case do they vary in proportion with the friction of the spindle; yet the variation is large, as shown by the following experiment made with the frame.

Mr. George Draper, in a communication to "The Industrial Record" of June 1, 1879, gives the following valuable data on this subject: —

"A frame of Sawyer spindles was taken spinning No. 30 yarn, ordinary twist, the front rolls running ninety-five revolutions per minute; the rings fifteen and one-eighth inches diameter, and the transverse of the yarn on the bobbin five and a half inches. The dynamometer was applied, and the power required to drive the spindles with a side pull of the bands averaging two pounds to a spindle was ascertained. The bands were then cut off, and a new set put on with a side pull of three pounds per spindle, and the frame tested again, all things remaining as before. The operation was then repeated at four, five, six, seven, and eight pounds side pull per spindle, with the result shown in the following table."

Calling the amount of power required to drive the spindles with: —

2 pounds tension	100
3 pounds tension	117
4 pounds tension	131
5 pounds tension	144
6 pounds tension	159
7 pounds tension	177
8 pounds tension	197

The results are shown, graphically, in chart E.

The lubricant used is one of the most important factors in the cost of power. In the present condition of engineering science, it is impossible to state what exact proportion of the power used by a mill is lost in sliding-friction; but, in a print-cloth mill, only about twenty-five per cent of the power is utilized in the actual processes of carding, spinning, and weaving fibre, not including the machinery engaged in the operation, leaving seventy-five per cent of the power as absorbed by the rigidity of belts, the resistance of the air, and friction.

The co-efficient of friction, under the conditions submitted by my oil-tester, vary at 100°, five hundred revolutions, from 7.56 per cent in the case of 32° extra machinery oil, manufactured by the Downer Oil Company, to 22.43 per cent in the case of Leonard & Ellis's valvoline machinery oil; and the result of this investigation confirms me in the opinion that the suc-

cessful operation of a spinning-frame is far more closely dependent upon the individual management in respect to the conditions of band-tension, lubrication, and temperature of the spinning-room, than all other causes combined. Not that some forms of spindle are not superior to others, but that without wise supervision the most desirable forms of spindles must fail to show the merits due to the skill of their promoters.

The charts show an increased co-efficient of friction at low temperatures over that of higher temperatures. In the case of mining drills operated by condensed air, an intense cold is produced at the liberation of air, and on such bearings kerosene oil is the only lubricant which can be used. I think it extremely probable, that at such a low temperature the viscosity of kerosene oil is equal to that of lubricating oils at the average temperature of bearings in general use.

According to the results which I have obtained, the co-efficient of friction at 50° is about seventy-five per cent in excess of that at 75°, and it seems to me that the manager of every mill which is run by steam ought to consider the question of the temperature of the mill in early morning during the winter months; whether, as a matter of economy, it is cheaper to warm a mill by increased friction on Monday morning, or to keep the mill and machinery warm during the interval from the preceding week.

The humidity of the atmosphere is an important factor in the mechanical operation of textile machinery, as well as in the fabrication of cotton. A year ago I submitted to the New England Cotton Manufacturers' Association measurements showing the effects of humidity on textile bands, and I am also of the opinion that there is a difference of friction in machinery due to atmospheric influences upon the lubricant.

Possibly the vapor condensing upon the cold metal from a moist atmosphere becomes commingled with the oil, and thereby decreases its viscosity, diminishing the friction.

The question of endurance of oils has not been given in these experiments, because the consumption of oil varies with the temperature; and it is proposed to investigate that matter subsequently by running the machine, and controlling the temperature of the disks to 100° by the circulation of water. The amount of oil consumed could be very easily measured by the difference in the level of the glass feeding tube, or the

weight of the oil required to preserve the oil at that level during the experiment. Great pains have been taken to procure pure samples of the oils experimented with. The lard and mineral oils were procured directly from the manufacturers as given subsequently; and to the courtesy of Thomas Bennett, jun., I am indebted for a large number of samples of sperm oils which were procured by him directly from the whale-ships or refiners. The following table gives the co-efficient of friction at 100° and five hundred revolutions: also, the results of some chemical examination of these oils by Professor Ellen H. Richards, of the Women's Laboratory, Institute of Technology: —

Resistance of Friction at 100 Degrees.

No. of Sample.	Kind of Oil.	Co-efficient of Friction at 100 Degrees.
28	Downer Oil Company, Champion	.1732
10	Downer Oil Company, Heavy spindle	.1187
14	Downer Oil Company, Heavy spindle	.1233
19	Downer Oil Company, Heavy spindle	.1208
7	Downer Oil Company, Light spindle	.1113
20	Downer Oil Company, Light spindle	.1132
8	Downer Oil Company, 32, extra machinery	.0756
2	Leonard & Ellis Valvoline spindle	.1476
11	Leonard & Ellis White Valvoline spindle	.1493
12	Leonard & Ellis Valvoline White loom	.1201
15	Leonard & Ellis Valvoline machinery	.2243
13	Olney Brothers, German spindle	.1190
16	Olney Brothers, A spindle	.1103
3	John P. Squire, Lard	.2181
4	Bleached winter sperm A	.1067
5	Bleached winter sperm B	.1217
6	Bleached winter sperm C	.1170
9	Aiken & Swift, Bleached winter sperm	.0956
17	Aiken & Swift, Unbleached winter sperm	.1147
18	Aiken & Swift, Bleached winter sperm	.1141
21	Seal Oil	.1608
22	Alexander Boyd & Sons, Neatsfoot	.2427

	Flash of Vapor Fahrenheit.	Loss by Evaporation in 10 hours at 140 Degrees.	Nitro-Sulphuric-Acid Test.
	Degrees.	Per cent.	
1			
10	338	1.3	Dark yellow with much cake.
14			
19			
7	314	2.7	Dark yellow, some cake.
20			
8	284	5.5	Slightly yellow, only a few flakes of cake.
2	316	3 7	Dark yellow, very thin layer cake.
11	324	3.9	Slightly yellow, not one brown speck.
12	318	3.3	Yellow, not a single flake, no solid matter.
15	286	7.2	Turned dark, gives a black layer of gum.
12	322	1 9	Quite an amount of cake.
13	282	5.0	Quite an amount of cake.
3		+0.4	Hardened with much acid to a white solid
4			mass.
5			
6			
9		+0.3	Thickened up a little like jelly.
17			
18			

With castor oil, the friction was so great as to throw off the belt driving the machine; and, as the time allotted for this work was at an end on that day, other arrangements for a wider belt could not be made, and it can only be said that its friction is much larger than that of any oil given in these tables.

A portion of a lot of unbleached sperm oil (sample 17) was bleached expressly for these tests (sample 18), but the results are so nearly uniform as to be practically identical. The result of bleaching does not affect the anti-frictional properties of the oil, although it undoubtedly reduces its gumming qualities.

The friction of sperm oil is subject to sudden variations which occur at certain temperatures for the same sample of oil. The explanation of this lies in the fact that sperm oil consists of a large number of varieties of spermaceti, each of which is liquefied at certain temperatures, at which the oil is relieved of waxy or at least gelatinous particles, and becomes a more perfect lubricant.

This is very apparent in the irregularities existing in the graphical representations of the tests of samples 5 and 6.

The operation of the machine under equal conditions with the same oil gives results which are as closely consistent with each other as could be expected from such physical measurements.

The anti-frictional properties of these oils, under the conditions of these experiments, are expressed in the following order: —

Downer Oil Company	32 extra machinery.
Aiken & Swift	Bleached winter sperm.
Olney Brothers	A spindle.
Downer Oil Company	Light spindle.
Aiken & Swift	Bleached sperm.
Aiken & Swift	Unbleached sperm.
Olney Brothers	German spindle.
Leonard & Ellis	Valvoline white loom.
Downer Oil Company	Heavy spindle.
Leonard & Ellis	Valvoline spindle.
Leonard & Ellis	White valvoline spindle.
Seal Oil: —	
Downer Oil Company	Champion.
John P. Squire	Lard.
Leonard & Ellis	Valvoline machinery.
Alexander Boyd & Sons	Neatsfoot.

The result of these experiments show that a lubricant must have a certain adhesion to the frictional surfaces to maintain free lubrication; but beyond that point the adhesiveness of the oil resists the motion of the surfaces, increasing the friction.

Slow motions and heavy pressures require a more adhesive lubricant than the conditions of light pressure and rapid motion, upon which these experiments are based.

It is no disparagement to the qualities of an oil, that it is low in the foregoing list, except so far as it relates to the resistance of friction under these conditions; for circumstances of great pressure and slow motion, I am of the opinion that the order of the list would be varied; and, if the question of endurance only were to be considered, still another change in the order would be necessary. Subsequent investigations will be made to determine some of these unsolved problems.

As the results with such a large number of samples of oil would occupy a large space in the records of this meeting, I will give to the secretary, to insert in the report, the graphical representation of some of the principal spindle oils in our market. And if any of the members wish more definite information, I should be pleased to reply to any inquiries that they may make, my address being 131 Devonshire Street, Boston.

Mr. George Draper. I wish to ask this practical ques-

tion. I have been situated sometimes where I have been running a mill by water, exhausted all the power I could get, and perhaps going a little below speed. Suppose you were running at any point in the machinery a hundred turns, and then, when we started up Monday morning with the same amount of power that we had before, how much ought the speed in that mill to be reduced? How many turns ought your mill to run, if your experiments are correct?

Mr. ATKINSON. Before that question is answered, I want to point out that any answer to that question, or any consideration of that subject, is based upon a guess, and only a guess, of the different power required to operate the substance that is being spun, and the power required for friction. I therefore think that any answer to the question will be only a guess.

Mr. WOODBURY. As my results are confined to the conditions of pressure and velocity, which I have stated several times, I have no data wherewith to answer that question. If the machinery of that mill was simply one vast Sawyer spindle, I could answer the question. The greater part of the friction of machinery is at a heavier pressure than the five pounds to the square inch which I have thus far experimented with, and the co-efficient of friction varies with the pressure.

Mr. DRAPER. It is not my intention to antagonize the speaker at all, for I have a great deal of confidence in his experiments. I simply wanted to draw out the matter.

Mr. ATKINSON. I want to be very sure that this point is understood: that all these experiments are based upon the machine adjusted to the conditions of the Sawyer spindle, and apply only to those conditions; not to operations of looms, or drawing-frames, but simply if the whole mill were a Sawyer spindle, then these conditions might apply.

Professor WHITAKER. The power which is consumed in driving the Sawyer spindle may be divided into three portions. The first is expended in working the cotton. The second overcomes friction in the bearings that are oiled. The third, which is by no means the smallest portion, overcomes the resistance of the surrounding air to the movements of the bobbins, bands, and other running parts. The resistance of the air increases nearly *as the square of the velocity*, and causes the *total* power consumed in spinning to increase more rapidly than the velocity of spinning.

Mr. GARSED. May I ask you, if it requires thirty-five miles of running to exhaust the oil from the pores of the metal in your frictional machine, how would it be in the case of cast iron and steel, cast iron being of such a nature as to retain the oil? How much longer or shorter would be the probable endurance of that cast iron in the bearings, as in shafting, for instance?

Mr. WOODBURY. I have given all the facts upon that point which I have obtained from my experiments, but from other experience I will say that where tallow was used in an engine cylinder, and one of the petroleum oils used subsequently, it was found by certain investigations made, that there were evidences of tallow in the cylinder for about six weeks.

Mr. GARSED. Then you would infer from that, that there would be evidences of oil found in the bearings of the shaft for a considerable time after you had ceased to use that oil?

Mr. WOODBURY. Yes, sir, and for a time probably exceeding six weeks.

Mr. GARSED. That confirms my own view: that is all.

The CHAIRMAN. Is there any thing further to be said upon the oil question?

Mr. ATKINSON. I wish to call your attention to the following facts: This machine — the first one ever made on which absolute results could be obtained — has been evolved during this investigation. The mechanism was devised by Professor Ordway; to that mechanism has been applied the invention of Mr. Waite, of conveying a current of water at a given temperature through the operating part of the machine; and, finally, Mr. Woodbury has added a very delicate dynamometer.

It will be remembered that Professor Ordway stated, as the result of other methods of investigation, that the best oil to lubricate spindles would be one that should combine a very high fire test, a low rate of evaporation, and the greatest degree of fluidity consistent with the oil remaining where it is needed, and not escaping.

This theory, based on other modes of investigation, is absolutely confirmed by the operations of this machine. Mineral oils, honestly made to meet these conditions, prove to be the most effective lubricants.

It will be remembered that we objected, as underwriters, to the volatile oils that showed a very rapid evaporation; and it is now certain that they were not only unsafe, but unfit to be

used, because very injurious to machinery if continued long in use.

The volatile portion of these oils cleaned bearings, when first applied, just as naphtha or kerosene will; but the next step was that the heat of the bearings continued, or perfected, the distillation of the oil, threw off the volatile portion in vapor and left the heavy portion on the machine. This heavy portion could only lubricate by being kept fluid at a high degree of heat. Hence it followed that those mills which used these low-priced but really very dear oils could only be worked by the use of an excess in quantity, and by maintaining the heat of the bearings at a somewhat high degree. They therefore combined the maximum of danger with the minimum of economy, and I am glad to say that they seem to have disappeared, — at any rate they are not offered to our members, as their dangerous and worthless character is sure to be detected.

I would here suggest that Mr. Waite be asked to give some of his further results with respect to durability of oil; and also suggest that in view of the fact that Mr. Waite's report which was to have been printed in the last copy of our proceedings, and which was excluded on account of the burning of the plates for the illustrations in the fire which occurred, — that the report be asked to be contributed to the Board of Government, to be by them published, if they see fit, in this report. Mr. Waite I think, would like to give us some further experience of his in regard to the durability of oils tested under similar conditions to these.

Mr. WAITE. I have little to say except to give you an account of a few experiments in applying results shown at the last meeting. First — to show the importance of using a fluid oil in preference to a thick one. In one of the spinning-rooms at the mill, we have substituted for Downer's heavy spindle oil, the Downer extra 32°. The oil was not changed on any part of the machine but the spindle bearings. With the same power and the same work, the speed of the top rolls increased from eighty-one to eighty-six turns per minute, showing a gain of six per cent in speed by using a lighter oil.

I have also tried experiments on heavy bearings with this light oil. I have put it on one of the heaviest and worst bearings in the mill. A hole was bored in the box-cover, a copper cartridge cap was cemented into the bottom so as to come as

near as possible to the journal without rubbing. This was filled with water, and a thermometer was placed in the water to show the temperature of the box.

I started with a gallon and a half of oil. The box was packed with asbestos, and as fast as the oil worked through it was caught in a drip-pan below, and used over again.

In running through once it lost about three pints, and continued losing until, after running through ten times, it had shrunk to less than a quart. The experiment lasted a month, and the thermometer showed the box to be from twelve to fifteen degrees above the temperature of the room. After the oil had been used once, a sample was taken for testing on the lubricating machine, and it was found that the oil had gained in lubricating value. A sample taken after the oil had been twice used showed an additional gain, but from this point the oil continued to lose slowly, until the end of the experiment.

Some heavy spindle oil was tried under the same conditions.

In running through once it lost about a quart, but after that lost very little.

The man in charge of these bearings tells me that a gallon and a half of oil, used over and over in this way, usually lasts about eight months, showing a durability eight times as great as the light oil. The oil, like the other, showed a gain in lubricating value after being used two or three times. The thermometer in the box indicated from fifteen to twenty degrees above the temperature of the room, — showing that the thin oil was the better lubricant although the more expensive one. At the last meeting I spoke of rough bearings, and said that the bearing surfaces may become so smooth by continual friction that the oil is easily pressed out from between them. Since then I have had opportunities for proving this, and, in the case of a number of hot boxes, all trouble was immediately stopped by draw-filing the surface of the shaft.

Mr. GEORGE DRAPER. You have said nothing about the bearings being injured. If the bearings are subject to be injured by the fact you have spoken of, which would wear the bearings out the sooner, the thin or the thick?

Mr. WAITE. I think there is less wearing in the case of the lighter. You cannot tear the particles of metal apart without occasioning an increase of heat. In the case of the light oils there was a decrease of heat.

There is one question that has not been looked into, and that is the influence of velocity on oils. A thin oil cannot be used to lubricate slow-moving surfaces. Although "extra 32°" oil was found to work well on the heavy bearing before mentioned, it could not be used on the top rolls of a spinning frame, notwithstanding the pressure was much less than in the former case. For this purpose an oil having more body must be used.

Mr. GARSED. Suppose you had a crank-pin of steel, and phosphor-bronze boxes, and could not keep them cool by ordinary oil, *i.e.*, by either sperm oil or mineral oil, — nor by any that you could find. Then what would you do if you had a crank-pin of a twenty-five-inch cylinder engine that was very difficult to keep cool? The boxes are phosphor-bronze, and the pin is steel, apparently fitted as well as modern practice can make it, and yet the greatest difficulty to keep it cool, so much so that a man stands oiling every five minutes. Now, what would you recommend to cool that pin?

Mr. WAITE. I think possibly it may have become polished. These hard surfaces running against each other would tend to polish each other in time, and become very smooth. I would recommend that the crank-pin be roughened a little, and then you would have no difficulty in using the thinnest oil you could get.

Mr. GARSED. There is a groove cut at angles across the boxes from the outside, probably one-sixteenth of an inch deep by a quarter of an inch the other way, to hold the oil.

Mr. WAITE. One groove will not do. If you have a number of very fine scratches, each one acts the same as a large groove.

Mr. GARSED. The reservoir of oil must be distributed in very small portions around this pin, — is that the idea?

Mr. WAITE. Yes, sir.

Mr. GARSED. But you want these grooves to hold the oil to prevent this wearing, or otherwise the cylinder becomes polished.

Professor ORDWAY. There are some points respecting this machine that Mr. Woodbury has not alluded to. It might seem strange that we have been so long in getting at apparently a few small results. I took hold of this matter without any prejudice at all, and soon found there was no machine that would give us any thing like uniform results. One was thrown

aside after another, until last summer I had this machine made by Browne and Sharpe. One of its excellences is that it is made as true as a machine can be. The disks were made of very hard steel, very highly polished, and perfectly true, so that when they are put together with a little oil between it is necessary to use force to separate them. This machine was calculated to run with two disks, both turning, and the friction was to be shown by the difference in velocity between the two disks. The upper one ran by friction, and the lower one by power. We soon found that the heat would have to be taken into account. It seemed desirable to modify the machine, and put on a direct dynamometer, so that we could weigh the power. Mr. Woodbury had this bronze box made, to put on in place of the upper steel disk. This gives us a chance to cool the bearings at all times, or keep it at a definite temperature, and allow it to rise as fast or as slowly as you please. We have now this apparatus, — which is a grist-mill to grind oil, in fact. No oil can get out except what passes between the two stones of the mill. A great many machines have failed from this circumstance: that oil in going around the shaft is wiped off by the edge of the bearing box, and there stays for a while, until there comes a time when a little of it will work in, and then all at once drops down your dynamometer, which shows a sudden change in the amount of friction, or amount of speed. This is the case with all machines that have half round bearings. They will go with great uniformity for a time, and then all at once there is a change, and then it comes up again where it was before, and then there is another change. That is owing to the fact that it is utterly impossible for any machine with half round bearings to keep the oil perfectly fed, and keep it from working out irregularly. The advantage of this machine is that that cannot happen. The oil must all go out by the centrifugal force. We are hoping to arrange it by and by so that we can tell what the endurance of an oil is. We can feed in a certain quantity, and know what will come out in a certain time. We shall make experiments upon the oils, and determine how much will wear out in a given time. This must, of course, be taken into account in determining the economy.

It took some time to build this machine. It came last fall when I was very busy, and could not be seen to until Mr. Woodbury could spare the time to take hold of it. He has

attended to it ever since with great constancy and fidelity. In the first place, it was necessary to get his bearing, and get it perfectly true. It was no easy matter to get that made as it should be. He has worked upon that for some time, and he has had a great deal of patience, and has finally got it into a very good condition, and every point about the machine has been worked out with scientific accuracy. Of course this has taken time, and the experiments which he is now making have been going on only for a short time. He has got, for the time he has been making experiments, a great many results. We are beginning to get at some data which will serve as a basis of calculation. The only point we have had time to attend to, so far, is this point, — as to the fluidity of the oil. It is certainly true that the fluidity of the oil is a very important point in lubricating power; and the point to be determined is whether that is the only point. I don't think it is the only point. It is the largest factor altogether, but there are other things undoubtedly. In the case Mr. Waite has mentioned, it seems to me that possibly in using the mineral oils, when there is an increase in the lubricating power after their being used a while, it is because there is an evaporation of the light oil; when that is entirely out, the lubricating power is increased. I have yet to determine whether taking a lubricating oil, and adding a small quantity of naphtha, it would increase or decrease the lubricating power. My feeling is that probably it would decrease the lubricating power; I should not be willing to say whether it would or not, except after a long series of trials. There is one thing certain, — that oil which has a low lubricating power may be increased in lubricating power by heat; but Mr. Woodbury's experiments seem to show that there is a limit to this rapid increase. We see *up here* [on the chart] these lines are getting nearly straight. It would seem as though after the bearings got up to one hundred and ten we need not expect any great increase of the amount of friction. This may be true only with low pressure. The lard oil we see goes in almost a straight line. In all these other cases we begin to come to a parallelism with the ordinate axis; and I suppose that the curve will be different in each case. We see in those Mr. Woodbury has tried, it works up *this* way pretty fast, and comes nearer and nearer to a parallelism. One point he has to determine with reference to the various animal, vege-

table, and mineral oils also, is where this uniformity or parallelism commences; and that would be the point at which those oils should be used.

I find one point very curious with regard to castor oil, — which is about as poor a lubricant as one could expect to find, — theoretically so, at least. It is an exceedingly viscous oil. I tried some on a new machine of a curious construction, and found that when the castor oil got up to two hundred degrees it was an excellent lubricant, and was superior to any of the mineral oils. The heat decreased the viscosity; but I should be very slow to suppose that merely heating would be sufficient in any such case. I think there is something in the nature of the oil itself. It is rather surprising to see the line for lard oil go so straight as it does. I think there must be a point at which the line would become vertical. Lard oil begins to come to that when we get to about one hundred and eighty; from that the friction does not decrease very much until you get up about as high as you could go with the machine. I don't know how much higher.

I hope the Association will have a little patience with regard to these experiments we are going on with. There is but a single point we have had time to try, because it has taken a long time to get a machine we could place any dependence upon. Mr. Woodbury has carried out the trials very faithfully, and certainly succeeded in doing what nobody else has done, except Mr. Waite, and that is, to get uniform results with the same oil on different days, and day after day, for ten or twelve or more trials. In all the trials we have any record of heretofore, there is a large difference between the maximum and minimum, which a man ought to be ashamed to put down upon paper. And yet we have these results paraded out upon paper as though they were very much to be depended upon. I sent my assistant Mr. Albright last winter to see experiments made with one of the machines, at the place where it was made, and told him to stay there until he could get two results which agreed with each other. He staid there a week, and found there was no prospect of it whatever, and came home. We are able with this new machine to get two results, and ten results, and I believe fifty, that usually agree very closely with each other, not merely within one per cent, but two-tenths of one per cent. Having a machine which will do this, I have

confidence we shall improve by and by. It will take time. With regard to the absorption of oil by metallic surfaces, it is necessary to take six hours running to wear out an old oil. Therefore these experiments must be made very patiently. Just about as much as you can in for one day,—six hours. You have to take one day for getting the old oil off of the machine, virtually, and then the next day you can make your experiment. It takes time, and a good deal of time. This, I think, shows conclusively that a great many of the experiments made heretofore, where a man runs for an hour or two, and wipes it off with waste, and runs again, are worth very little. They may be practical in a certain sense, but they have nothing like scientific accuracy. The points we want to get light upon are those in which we need scientific accuracy. This single point, if we can determine it, will be worth all the cost of these experiments, and that is to determine whether fouling is the chief, or the only factor in lubrication. I think it is the chief factor, and I don't think it is the only factor; and I think that must be determined by a long series of experiments.

The heat increases as the speed increases. We shall have a good exhibition of the matter from seeing how far the oil settles in this glass tube. We see no sudden changes there, whether it runs at a high speed or a low speed. It does have a tendency to vary the speed. If it runs down to three hundred we see a difference in its curve.

Mr. BIRKENHEAD. You have, I see, in this machine a cast-iron disk or frictional surface in contact with a composition surface; which calls to mind the trouble I have experienced in lathes that I have had in constant use for a number of years, some having been provided with composition boxes, and some with cast iron. Most of those with cast iron have been in constant use for about fourteen years, and appear in as good order to-day as the day they were started, and those having composition have been a source of great annoyance; as a lathe is useless unless the spindle fits snug, and in line. I have made some special tools, and made both the spindles and boxes of cast iron; and no wear is perceptible. I find the bearing surface becomes enamelled or case-hardened, so as to resist the action of a file.

Professor OLDWAY. The cast-iron boxes are much more ... than the others. That would agree with the statement ... Waite.

Mr. BIRKENHEAD. It becomes like the slide-bar of an engine. You have to plane off the surface in order to touch it at all.

Mr. ATKINSON. There is one word to add: that these experiments have been carried on by Mr. Woodbury, in connection with pump experiments. He will now be obliged to take that subject up. But arrangements have been made whereby this series of experiments may be continued. I think you will be able to find that it is worth while to make them. We have had a great deal of consideration for the power required by spindles. I have had occasion to say I doubted the element of the weight of the spindle itself, and did consider the pressure of the banding as of the utmost importance. It is certainly desirable to reach a determination of the measure of the pressure of the band with one oil, another oil, and a third oil. I think we are approaching results which, as I forecast the future, — with that machine, and the dynamometer attached, — if sufficient time and skill be given to the subject (of which we have had several cases to-day). I think we are approaching the time when results may be reached in regard to the proportion of power required to operate the shafting and machinery, and that required to operate upon the fibre itself; I think that may be determined, and scientific results obtained. If so, that will be the end of the vague and indefinite quest on which we started.

Mr. GARSED. One word, if you please. I asked the question upon the subject of cast-iron journal-boxes, not because I wanted an answer on the journal-box; but we have used cast-iron steps and bolsters on spinning-frames since 1872, and have not taken out five of either in that time, running 7,700, while bronze, I think, have been renewed once at least in that time; and it now appears by these experiments that the cast-iron, being porous, holds the lubricant, and gives it out in time to save the bearing from cutting out.

Mr. BIRKENHEAD. With my experience, I would not dare to recommend it for spinning spindle bearings except on certain conditions; namely, with an elastic bearing it may prove a success.

Mr. GARSED. I don't recommend it. I only state the facts.

Mr. BIRKENHEAD. I have seen facts to the contrary of what Mr. Garsed has said was his experience, and would say here, that the conditions should be understood; for what may be food for one creature may poison another.

Professor ORDWAY. There is one thing that might strike people as different from that a little. Gentlemen have stated that these bearings get exceedingly hard, and they therefore might be supposed to have a surface which was not porous. They still lubricate easily. The fact is, they might become as hard as steel, and yet retain their porosity. You will see this if you compare the ordinary flint rock with the burr-stone. The latter is porous, and it is this quality which makes it valuable for millstones. It is exceedingly hard. So a cast-iron bearing may wear hard, and yet retain a good deal of its spongy character.

Mr. ATKINSON. I have but one word more to add. These experiments have been carried on by our Mr. Woodbury during the winter, when his regular work as pump-inspector ceases, but he must now return to that. Arrangements are, however, being made for continuing these tests.

During the past years a great deal of consideration has been given to the power required to drive spinning-frames, and a contest on the weight of the spindles. I have often had occasion to say that the mere weight of the spindle was relatively unimportant as compared to its adjustment and to the tension of the band, and that a very light spindle might require greater power if subjected to a severe tension of the band. This opinion has been confirmed by experiments of this machine. We have worked this machine, subject to variations in its adjustment equivalent to variations in the tension of the bands on spinning-frames, and we find that such alterations make a greater difference in the power required than any difference that is claimed between the so-called light and heavy spindles.

I think we shall soon be able to use this machine so as to give absolute results in respect to friction under almost any conditions, and to determine with positive certainty what kinds of oils are best for light bearings at high speed, and heavy bearings at low speed.

In the conduct of these experiments we have secured very much greater safety from fire, and I feel very sure that we shall also bring the subject of lubrication almost if not quite to the condition of an exact science.

The CHAIRMAN. Is there any thing further to be said upon this matter of oil? If not, there is a gentleman from the Arsenal present, Mr. Howard, who will now address you.

Mr. HOWARD. In October last some tests of steel shafting were made at the Watertown Arsenal. More recently Jones & Laughlins, manufacturers of cold-rolled shafting, have had some tests made of their metal. Before speaking of the details of those tests, I will mention a few circumstances connected with the testing-machine, upon which the tests were made; one of the most complete and accurate machines in the world. This machine was built by the inventor, Albert H. Emery of New York. The time occupied in its construction was about three and a half years. This length of time was in excess of what was at first supposed would be necessary. The length of time was accounted for from the fact that many new and untried principles of mechanics were adopted in the machine. The work was brought to a successful completion, and the machine has been in operation for a little over a year, performing very valuable tests. In the last six months alone it has been in about constant operation, during which time some sixty thousand pounds of metals have been tested. This machine is a hydraulic testing-machine. It has, for its principal parts, the straining-press, twenty inches in diameter, a stroke of piston of twenty-four inches, two main screws, each forty-eight feet long, eight and a half inches in diameter, with thread cut about thirty feet on each. The main screws connect the straining-press with the platforms of a hydraulic scale. From these platforms are pipes transmitting hydrostatic pressure to the scale, where hydraulic supports are placed, acting on multiplying levers; and, as a remarkable feature about this scale, it is frictionless, and capable of showing very slight loads. It has been tested very severely, passing, in one instance, from the testing of a specimen requiring seven hundred and twenty-two thousand pounds tension to a specimen requiring only one pound tension, to break it. Each of these strains was accurately weighed. Duplicate weighing apparatus was provided; that is, a hydraulic scale, weighing from one end, and pressure-gauges, with twenty-inch dials, measuring the strain of the straining-press. The scale, being frictionless, gives the exact load on the specimen. The pressure-gauges are subject to the packing friction of the press. Having these two systems, we can see at once the exact packing friction, and also have a means of determining about what the accuracy of other testing-machines are which depend merely upon pressure-gauges at-

tached to hydraulic presses. Instead of pumping the oil that is used in the straining-press directly into the cylinder, an accumulator is used. This consists of a vertical cylinder, with two plungers, one ten inches in diameter, and the other five and a half, one working within the other. Upon these plungers three masonry weights are carried; with one weight resting upon the larger plunger. The minimum pressure per square inch is three hundred and eighty pounds. The maximum pressure — three weights upon the smaller plunger — is thirty-eight hundred pounds to the square inch. The hydraulic pressure-gauges are accurate, beyond any that I have heretofore known. They read so accurately that the same strain will bring the needle of the gauge within one one-hundredth of an inch of the same position, with the same load, whether the reading is when going up or down. The ordinary gauge displays considerable discrepancies in the upward and downward readings.

The tests of steel shafting, which were made for Mr. J. W. Cumnock, were of Siemens-Martin steel, manufactured by Benjamin Ather of Newark. The shafting was turned by the Ames Manufacturing Company. The results were published in the last semi-annual report; but I will review them. The elastic limit of these specimens was from 44,000 to 56,000 pounds per square inch. I have considered the elastic limit of this material as that point, — or the highest load which the metal would sustain, and return to its original length, after the load had been released. This definition is at variance with one sometimes adopted, in which the elongations of the specimen fix the elastic limit; i. e., the elastic limit is considered as the point where the elongations cease to be proportional with the increments of load. If the latter definition was accepted, then the elastic limit of this material would be considerably elevated beyond the figures I have stated. Some of the test-bars of Mr. Cumnock, in which I considered the elastic limit to be 45,000 pounds per square inch, took 12,000 pounds per square inch additional load to produce .003 permanent set, in about a foot length. The permanent set was not increased very materially until nearly 58,000 pounds per square inch was reached. The ultimate strength of Mr. Cumnock's specimens was determined only in three cases; the elastic limit, in all but two. The limit of strength was found to be from 93,000 to a little over 94,000 pounds per square inch. The

total elongation, after fracture, was from 14.6 per cent to 17.6 per cent, — reducing the diameters very considerably. The bars were well drawn down.

At the same time Mr. Cumnock desired a test made of a bar of Nashua iron, which gave an elastic limit of 25,000 pounds per square inch, — about one-half that of his steel, — and an ultimate strength of 49,000 pounds, — which was coincident with the elastic limit of his steel specimens.

In the tests which have just been completed, the first bar tested was three inches in diameter, the total length eight and a half feet, — or between the faces of the dies used for holding the specimens it was fifty inches. An untreated specimen of ordinary turned iron had an elastic limit of 21,500 pounds, and an ultimate strength of 49,000 pounds per square inch. A cold-rolled specimen of the same iron had an ultimate strength of 47,500 pounds, — 2,000 pounds per square inch less than the untreated specimen; but the elastic limit in this case was raised until it coincided with the ultimate strength. A bar of three-inch Bessemer steel showed an elastic limit of 40,000 pounds per square inch, and an ultimate strength of 66,700; and, as was the case with the cold-rolled iron, the steel had its elastic limit raised by cold-rolling until it was coincident with the other. In each of these cases the ultimate strength was reduced about four per cent. The elastic limit really fixes the practical limit of the value of the material, for ordinary purposes; and that is increased by the process of cold-rolling about one hundred and twenty per cent. A bar of four-inch turned iron has been tested, and another bar of the same is at the present time in the testing-machine, having been loaded with 40,000 pounds per square inch. The resilience, or shock-resisting power, of the metal is increased in about the same ratio that the elastic limit is raised, with the cold-rolled shafting. Professor Thurston, in the experiments he made with cold-rolled metal, at the Stevens Institute, and some made at Pittsburgh, found the ultimate strength of cold-rolled iron to be from 64,000 to above 70,000 pounds per square inch. Those results have not been verified by tests at Watertown. The ultimate strength of the shafting at Watertown was less with the cold-rolled bars than with the untreated. The elastic limit which was found at Watertown corresponds very closely with the results which Professor Thurston found. The bar of

four-inch iron which is now in the testing-machine will require but a short time to break it, and it will illustrate the action of the testing-machine very well. I will extend a cordial invitation to any members of the Association who may feel disposed and be able, to come out to the Arsenal, either this afternoon or to-morrow forenoon, and make an examination of the testing-machine, and witness the testing of a four-inch bar of cold-rolled shafting.

Mr. CHARLES S. LOVERING. I would like to offer one suggestion upon a matter which, it seems to me, would be of interest to the Association. It is upon the matter of statistics, as regards the cotton crop. It is something that interests every manufacturer in New England. It is safe to say, that, during the last winter and spring, the manufacturers of New England have paid from half a cent to a cent per pound, at least, more than they ought to have paid for their cotton, in view of to-day's condition of the subject. Now, what I want to say is this: When a treasurer goes into the market to buy his cotton, he is subject to all sorts of estimates that have been made as to what the cotton crop is to be; and he is at once the subject, or the victim, of an incompetent agricultural bureau at Washington, which is maintained only to support a lot of political bummers; or he must take the other horn of the dilemma, and receive the report of the Cotton Exchange, which is made up solely with reference to different opinions there, and for purposes of speculation. Now, what I want to come at is just this: It would seem desirable, if possible, to effect some reform in the Agricultural Bureau, at least that part of it which relates to the statistics upon cotton. Now we are on the eve of a very accurate census, probably the most accurate ever taken. It would be a pity if we could not, from these data, be able, by another season, to get at some accurate estimate of the cotton crop. Of course, you may say it is all a matter of guess; and I have, within a few days, in correspondence with Mr. Walker, the chief of the Bureau, learned the miserable method adopted there by the Agricultural Bureau to obtain the statistics. It is the merest film of guess-work ever thought of. I learned from him that it is possible for us to do better than has been done; and if we were in England, or if this were an English association, I have no question that it would put forth every effort to secure an

accurate estimate of the crop. To-day, you may say, the best estimates we get are those that we get from individuals. So they are. In looking over the estimate of "The Financial Chronicle," you see at once it refers to the Bureau. What I would like to have done would be to have this Association clothe some committee with sufficient power to go to that Bureau, and, if possible, effect a reform; and, if it be not possible to effect a reform there, to see if it is not possible to establish some inexpensive method by which we can know, somewhere nearer than we already know, or have any means of knowing, what the cotton crop is to be. There is much that can be said upon the subject. You may say, after all is said and done, that it is a mere matter of guess; and when the Agricultural Bureau make such tremendous mistakes as they have done last year, I submit the subject for the consideration of the Association, in the hope that they may see fit to at least inquire into the matter, and see if some improvement cannot be made.

Mr. ATKINSON. Mr. Lovering asked me to say to you a word: I don't know as I can add any thing to what he has stated. The "official" statements of the Bureau of Agriculture have more weight, a great deal, because they are "official," than they deserve. The final "official statement" of this year, after having indulged in one guess of 4,800,000 bales, stated that the crop would be 5,080,000 bales, which was so obviously incorrect, that, at the time of my printing that chart which I exhibited some time ago, I had to add a note, that "commercial estimates varied from ten to fifteen per cent, in excess." And at that time my estimate, from what I could learn, was, that it was not less than from 5,400,000 to 5,500,000 bales. In my judgment it would be far better for the Agricultural Department to confine its estimates to acres planted, and statements of the weather, rainfall, &c., leaving commercial men to make the crop estimates in bales.

The more the Department indulges in crop estimates, the more we shall be misled if they are regarded at all.

The CHAIRMAN. Is it the pleasure of the Association to take any action in regard to the subject of obtaining the statistics of the cotton crop?

Mr. LOVERING. I would move that it be submitted to the Board of Government, with instructions to ascertain if any reform or change can be made.

[The motion was adopted.]

Mr. ATKINSON. These experiments at Watertown are of great interest and importance. I understand that Mr. Howard invites the members of the Association to come out there to-morrow, and see one of these tests made. I would suggest that he name the hour at which persons may leave the city and arrive there in season.

Mr. HOWARD. Half-past nine o'clock is a convenient hour, I think.

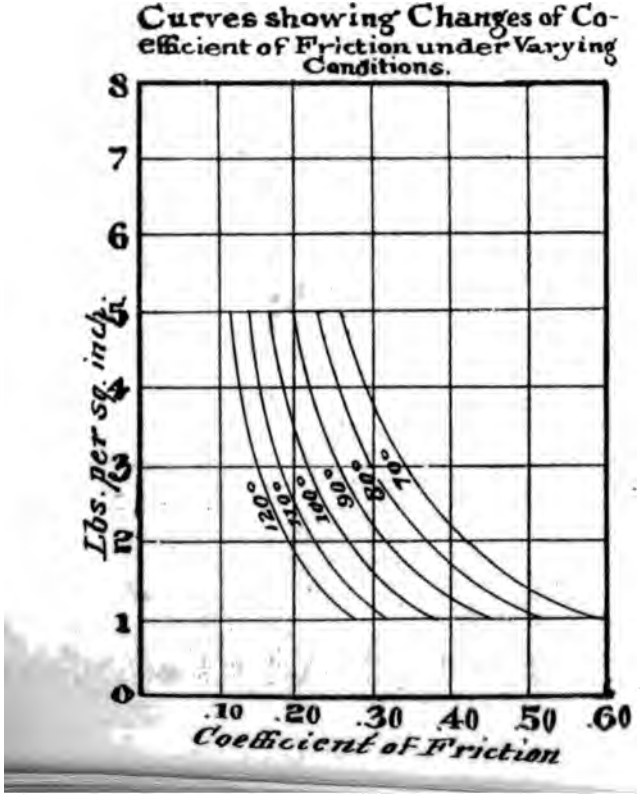
Mr. ATKINSON. That would be a convenient hour for most of the members. There is a train on the Boston and Albany road at that time.

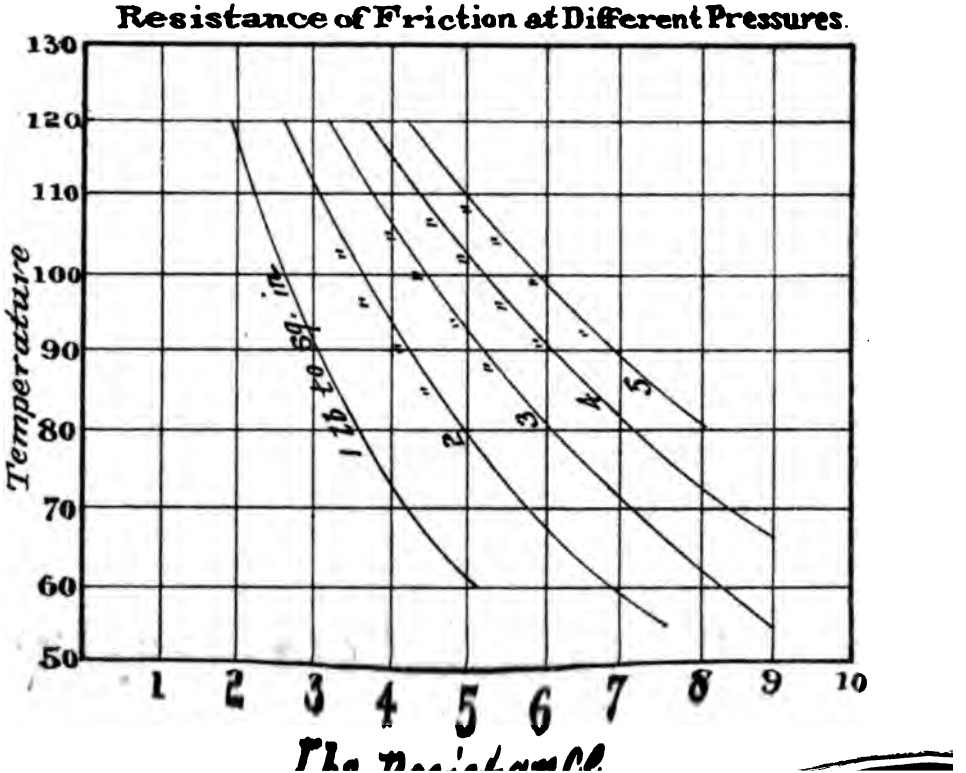
There are some test-pieces on the table, of Mr. Cumnock's draughting, which are for inspection.

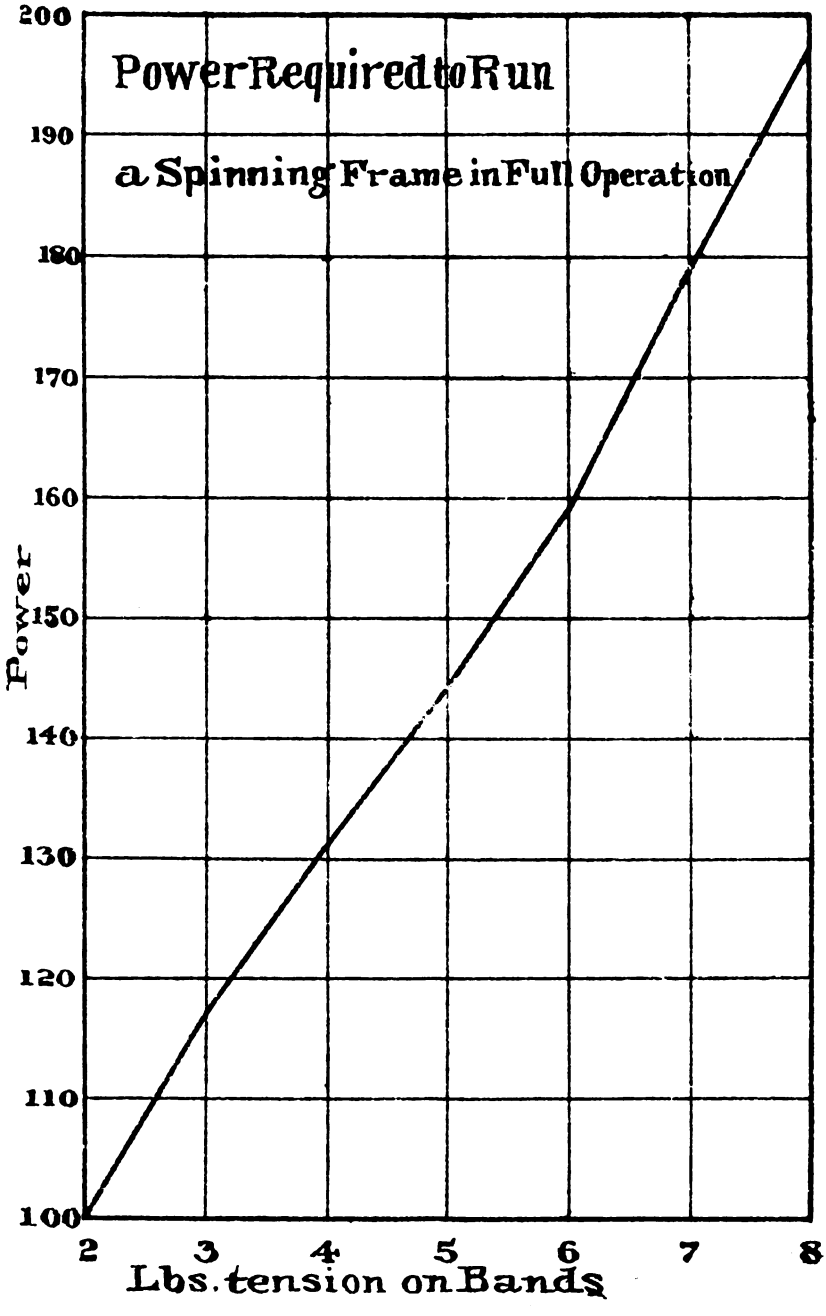
Mr. GARLAND. I had hoped to be here when the matter of tare was spoken of. I wanted to say in regard to tare, — and it is in connection also with this subject that has just been brought up, — that perhaps the cotton crop would appear much less if there was not water mixed with the cotton. I had my attention called to this subject somewhat by the remark of Mr. Atkinson at the last meeting, when he said that the cotton was put out of doors in rain-storms, and put into wet cellars. I have made experiments upon this subject, and found this to be true, — that some cotton brought to the mills loses in drying ten per cent. If you will take the cotton, and put it into the same condition of climate, — sixty-five per cent humidity, — you will lose from two to five per cent. Some that I tried lately lost 6.56 per cent. Manufacturers are losing two to five per cent of cotton, in consequence of the water that is in it, which should not be there, and does them no good. How are you going to remedy this? I don't know. I hope this subject will be brought before the Association at another time. I want to say another thing: that if your cotton is not brought into the same climatic condition here as it is where it is raised in the South, you will also lose from three to five per cent in weight of your cotton, and twenty to thirty per cent of the strength.

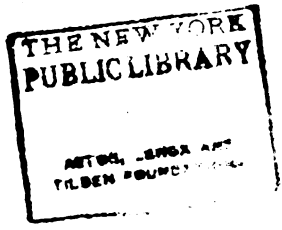
[The four following pages are diagrams illustrating Mr. WOODBURY'S remarks.]

[Adjourned.]


Curves showing Changes of Coefficient of Friction under Varying Conditions.
Lbs. per sq. inch.
Coefficient of Friction
0
1
2
3
4
5
6
7
8
.10
.20
.30
.40
.50
.60
120°
110°
100°
90°
80°
70°


Resistance of Friction at Different Pressures.
Temperature
130
120
110
100
90
80
70
60
50
1
2
3
4
5
6
7
8
9
10
1 lb. per sq. in.
2
3
4
5


Power Required to Run
a Spinning Frame in Full Operation
200
190
180
170
160
150
140
130
120
110
100
Power
2
3
4
5
6
7
8
Lbs. tension on Bands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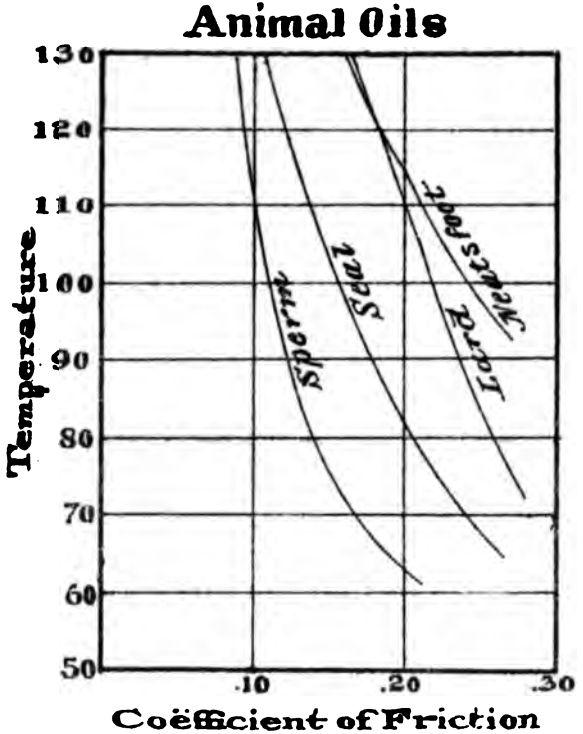
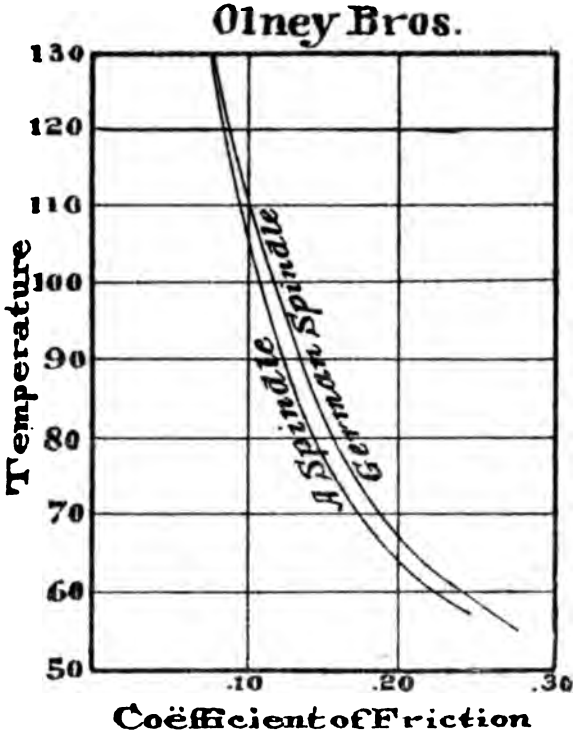
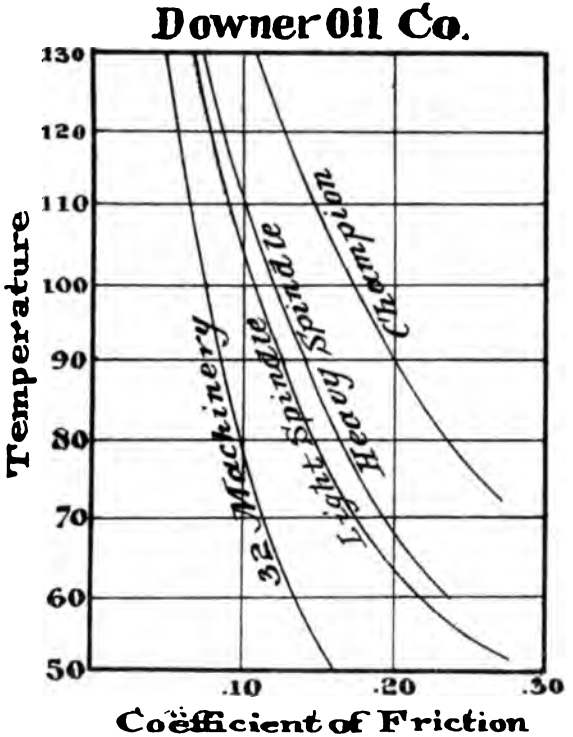
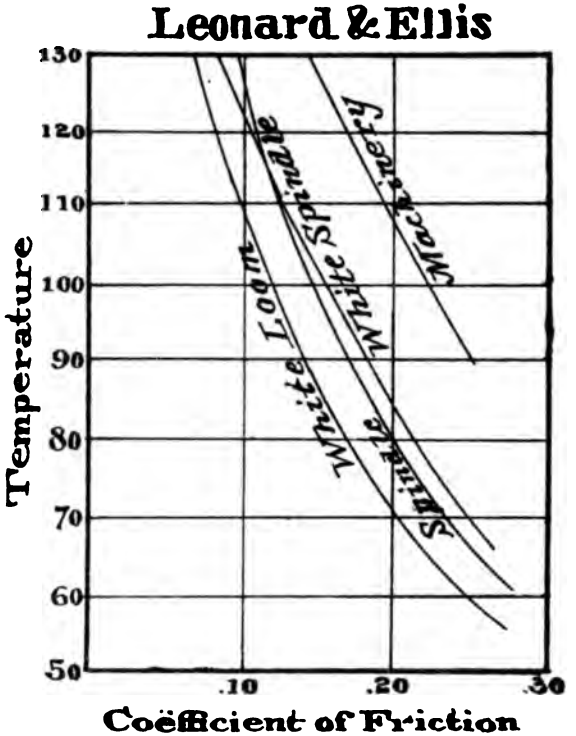

Animal Oils
Temperature
130
120
110
100
90
80
70
60
50
.10
.20
.30
Coëfficient of Friction
Sperm
Seal
Lard
Neatsfoot


Olney Bros.
Temperature
130
120
110
100
90
80
70
60
50
.10
.20
.30
Coëfficient of Friction
A Spindle
German Spindle


Downer Oil Co.
Temperature
130
120
110
100
90
80
70
60
50
.10
.20
.30
Coëfficient of Friction
32 Machinery
Light Spindle
Heavy Spindle
Champion


Leonard & Ellis
Temperature
130
120
110
100
90
80
70
60
50
.10
.20
.30
Coëfficient of Friction
White Loom
White Spindle
Machinery
Spindle

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REMARKS OF CHARLES N. WAITE, Esq. (Manchester, N.H.).

[Submitted at Association Meeting, October, 1879.]

MR. PRESIDENT, — When we lubricate two rubbing surfaces, we substitute for the resistance of the metallic particles, the resistance which the particles of oil give in moving over each other.

Now, the resistance to motion which the particles of any oil offer, is known as its viscosity: hence we ought to be able to lay down as a law *a priori*, that the fluidity of an oil is a perfect measure of its lubricating-power, that any thing which affects the fluidity affects the lubricating-power in just the same degree. And this has been proved by actual experiment.

The viscosity of oils at different temperatures was determined by finding the amount which would flow through a given orifice in one minute under a constant head. The amount of natural winter sperm which flows in one minute at a temperature of 60° Fahrenheit was taken as the standard.

Plate I. shows the variation at different temperatures in the viscosity of the more common lubricating oils, as determined in this manner.

At 60° Fahrenheit, the viscosity of sperm being 1.00, neatsfoot is 3.20; lard, 2.30; olive, 2.18; paraffine, 25° grav., 1.23; paraffine, 29° grav., 1.06. As the temperature rises, the viscosity rapidly decreases; neatsfoot being most, and sperm least, affected by variations in temperature. You will notice that while at 60° Fahrenheit, sperm is twenty per cent thinner than the heavy paraffine, yet at 100° it is ten per cent thicker, the viscosity of the paraffine having diminished so much more rapidly than that of sperm. At 250° Fahrenheit the oils are nearly all of the same degree of viscosity.

Now, since the viscosity of all oils is so sensitive to the influence of heat, it becomes at once apparent, that, in order to determine the lubricating quality of an oil by a frictional machine, we must have some method of regulating and determining exactly the temperature of the film of oil between the two moving surfaces, and the trials must always be made at the same tem-

perature. This is best done by making one of the bearing plates hollow or cup-shaped, and passing a continuous stream of water through it, in order to carry off all the heat generated by friction. By this means the temperature can be regulated at will, and different trials of the same oil made at different days do not vary more than one per cent.

The resistances of oils under variations of temperature were found to follow almost exactly the viscosity curves shown in Plate I. Plate II. shows the relation between the viscosity and lubricating-power of lard and of light paraffine oil. The dotted curves are enlarged copies of the curves shown in Plate I., while the full lines represent the readings on the frictional machine at different temperatures, multiplied by a constant. Neither the readings on the machine nor the viscosities of the oil were determined in duplicate, for want of time, so that they lack scientific accuracy, but they are correct within certain limits. The true curves are probably regular, and their form may be mathematically determined.

Plate III. shows the relative value of lard, neatsfoot, heavy and light paraffine and sperm oils, as lubricants. You see that they bear about the same relation as shown in Plate I.

The lubricating value of oils is affected by moisture. It affects mineral oils very little, making them run heavier in the bearing. The mineral oils have very little tendency to absorb moisture from the atmosphere. On the contrary, fatty oils are somewhat hygroscopic, and are all strongly affected by the least trace of moisture. The table shows the effect of moisture on on fatty oils. The resistances are the readings taken directly from the machine, with a speed of about 270 feet per minute and a load of two pounds per square inch.

Temp.	Neatsfoot.		Lard.			Sperm.	
	Dry.	Moist.	Dry.	Moist.	Containing 1% Water.	Dry.	Moist.
	Resistance in Ounces.		Resistance in Ounces.			Resistance in Ounces.	
70°		127 0		164 0		108 0	102.5
80°	180.0	112 0	168.0	157.0		100.0	92.5
90°	164 0	104.0	155.0	146 0		94.6	83.8
100°	146.0	94.0	140.0	126 0	65.5	85.1	79.0
110°	137.0	72.0	127.0	118.0		78.0	70.5
120°	127.0	61.0	118.0	106.5		74.7	66.2
130°	117.5	45.3	108 5	98.0		67.3	54.0
140°	104.5	41 5	94.0	93 5		60 3	

The "dry" oils were dried at a temperature of 120° Fahrenheit for several hours; the "moist" oils were just as they were received from the dealers, except in the case of the lard oil containing one per cent of water. In this case the water was simply shaken into the oil, without any alkali being used to carry it. The moist neatsfoot was slightly cloudy at low temperatures; but the lard and sperm were bright and clear, and would ordinarily be called dry oils. Fatty oils are so sensitive to moisture that the machine would run several per cent lighter, if oiled at the ordinary temperature of the room, than it would if heated to 140° Fahrenheit before oiling, in order to expel all moisture from the pores of the metal. All the resistances shown in the plates are with oils carefully dried as above.

It has been generally believed that the co-efficient of friction of an oil was the same under all pressures, — that, if the load were doubled, the friction would be doubled.

Experiment has shown that if the *rubbing surface* be doubled while the load per square inch remains the same, the resistance is double: if, however, the load per square inch be doubled, the resistance is only increased from 1.3 to 1.5, according to the kind of oil used.

Plate IV. shows the effect of pressure on oils. The ordinates show the resistance in ounces at 100° Fahrenheit, and the abscissæ show the load in pounds per square inch. Starting with paraffine oil, 29° gravity, you will notice that the friction under a load of two pounds is 1.29 times the friction under a load of one pound; and the resistance increases in this ratio until we reach a load of twenty-two pounds per square inch. At this point the curve becomes a straight line, and the co-efficient of friction remains the same for all loads. Are we not justified in saying that with this oil we have perfect lubrication with any load under twenty-two pounds per square inch; that the metallic surfaces do not come in contact; that all the friction is due to the particles of oil moving on each other; but that above this point the metallic surfaces actually come in contact, and there is more or less wear on the bearings?

Neatsfoot oil increases in the ratio of 1.31; i.e., the friction under a load of two pounds per square inch is 1.31 times the friction under a load of one pound. What we may call the "squeezing point" of the oil — the point at which the oil is squeezed out, and the surfaces come in contact — is not reached

under eighty-four pounds per square inch, the highest load with which the machine could be run. Nevertheless the oil is so viscous that with any load under seventy-two pounds per square inch, it requires more power to overcome the friction of the oil-particles, than in the case of the imperfect lubrication with paraffine oil, although in the latter case the wear on the bearing surfaces is greater.

Lard oil has a ratio of 1.29, and the "squeezing point" is reached with a load of forty pounds per square inch.

Sperm oil has a ratio of 1.50, and the "squeezing point" is about seventy pounds per square inch.

A survey of the above data seems to show that for all pressures under seventy pounds per square inch, a light paraffine oil is the best lubricant; for, although there is some wear on the bearings, still experience shows that it is so slight as to have no practical importance, while the saving in power required to overcome the friction is greater with a light paraffine than with any other oil. For higher loads the best lubricant is a heavier mineral oil, although this should never be heavier than 25° gravity.

The addition of tallow, suet, or other solid fats, to a mineral oil, is not to be recommended, since this mixture is pressed out from between the bearings as readily as a pure mineral oil, and being thicker and more viscid it offers more resistance to the power.

A few words as to the bearing surfaces themselves. It is important to have good lubricants, but it is more important to have the bearing surfaces in the proper condition.

If two accurately fitting surfaces be highly polished, it is almost impossible to keep any kind of a lubricant between them. A slight pressure squeezes them dry, and they bite together at once. It has been impossible to determine the exact pressure needed to bring the surfaces together under these conditions, on account of the difficulty of making two surfaces to fit accurately with the means at hand; but it is far below what is generally believed at present. If we take a shaft bearing that has been turned true, and roughen the surface either by draw-filing or with moderately fine emery, we shall get a surface which gives the least resistance to motion when lubricated. A surface of this kind under a moderate load gave less than one-seventh as much as a finely polished surface under the same conditions.

The explanation of this seeming paradox is this: When we lubricate two moving surfaces, we separate them by a thin cushion of oil. The metallic surfaces do not come in contact with each other; but if for any reason they do actually rub, it makes no difference how smooth they may be, they will heat. Our whole care, then, is to see that the lubricant is kept between them; and this is best done when they are slightly rough, since in this case we may consider the load as resting on a number of points or ridges, and each little depression or scratch may be considered as a minute cup which carries oil, and spreads it over the adjoining ridges as fast as they become dry.

APPENDIX.

REPORT ON TENSILE TESTS OF TURNED AND COLD-ROLLED IRON AND STEEL SHAFTING

MANUFACTURED BY

JONES & LAUGHLINS,

PITTSBURGH, PENN.

THE tests herewith submitted will illustrate the benefits of cold-rolling as applied to shafting. Six test pieces were prepared, forming three sets of experiments, in each of which there is one bar of turned and one bar of cold-rolled shafting of the same metal and size. The effect of cold-rolling, therefore, is clearly indicated, and by direct comparison the value of the process may be shown. These bars are believed to be larger than any cold-rolled specimens heretofore tested. The importance of testing full-sized specimens can be best appreciated when we consider the fact that the test of small samples does not in all cases correctly indicate the true strength of the metal. To overcome expected difficulties in securing the test pieces to the testing-machine, they were provided with eyes at the ends, through which pins were passed; and, furthermore, the bars were held by friction dies, leaving a clear length between the faces of the dies of fifty inches.

It was not considered feasible to weld on heads to cold-rolled bars that would not fracture at the welds if held by pins alone. The above method of holding proved successful with five bars: the sixth broke in the eye.

The elastic limit, which determines the practical value of a metal, by the process of cold-rolling is very much elevated: with the three-inch iron it is raised 121 per cent, and with the Bessemer steel 60.7 per cent.

In addition to the elevation of the elastic limit, the power of the metal to resist shocks without permanent change of form is increased as shown by the column of elongations at elastic limit. This in-

crease of resilience took place in about the same ratio the elastic limit was raised.

Specimen C 2 was strained in the machine with 40,000 pounds per square inch, the load released to 1,000 pounds per square inch, and then allowed to rest three days. At the end of this time it sustained 57,220 pounds per square inch, taking a permanent set of only .019 of an inch in twenty-four inches in length. The bar then broke in the eye, leaving the ultimate strength of the bar still undetermined.

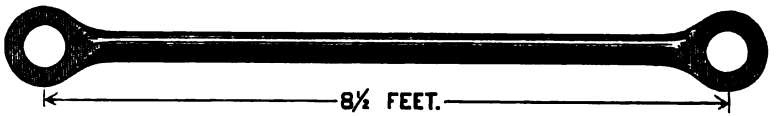
It has been shown by earlier experiments that the elastic limit and ultimate strength both could be raised by applying a strain to a specimen in excess of the elastic limit and allowing the bar to rest.

This may be an explanation why the last bar should give results not in conformity with the other bars, it having been previously strained above the original elastic limit of the metal.

Respectfully submitted.

JAMES E. HOWARD.

WATERTOWN ARSENAL, April 27, 1880.



Distinguishing Mark.	Description of Specimen.	Part Tested.		Sectional Area in Square inches.	Elastic Limit.		Ultimate Strength.		Elongation at Elastic Limit in per cent.	Total Elongation after fracture. Per cent.	Contraction of Area. Per cent.	Appearance of Fracture.
		Diameter.	Length.		Actual Load	Pounds per Square inch.	Actual Load.	Pounds per Square inch.				
		Inches.	Inches.									
A 1,	Turned iron .	3	50	7.068	151,962	21,500	349,000	49,380	.079	16.8	36.1	Fibrous.
A 2,	Cold-rolled . .	3	50	7.068	339,264	47,500	339,264	47,500	.183	0	0	Granular.
B 1,	Turned steel .	3	50	7.068	282,720	40,000	471,600	66,720	.140	4.7	4.9	Granular.
B 2,	Cold-rolled . .	3	50	7.068	454,500	64,300	454,500	64,300	.216	0	0	Granular.
C 1,	Turned iron .	4	50	12 566	226,188	18,000	608,500	48,420	.066	13.4	23 5	Fibrous and granular.
C 2,	Cold-rolled . .	4	50	12.566	502,640	40,000	Above 720,000	Above 57,220	.171			

Note. — Specimens distinguished by the same letter are of the same metal.

UNITY OF THE COTTON KINGDOM.

[Article read before the March meeting of the Mississippi Valley Cotton Planters' Association, and to be submitted to the Annual Meeting in May.]

BOSTON, March 29, 1880.

F. C. MOREHEAD, ESQ., *President.*

Dear Sir, — As the planting interest is the foundation of the cotton kingdom, a kingdom that ought to be a unit, I beg to submit through you to the Mississippi Valley Cotton Planters' Association, over which you preside, the following suggestions, which you are at liberty to make use of if you think them of sufficient importance:

The question of the right method of preparing cotton should take the lead. It is a maxim with cotton manufacturers, that "cotton well carded is half spun," and so it may also be that "cotton well ginned is half carded."

In respect to this subject, I start with this assertion that the saw gin, of whatever make, is a barbarous or semi-barbarous machine, unfit to be used.

If a consideration be given to the form and structure of the cotton fibre, this will become obvious to every one.

The fibre of cotton in an immature state is a cylinder containing sap, fastened at one end to the seed, and pointed at the other end. When it approaches maturity the sap is absorbed, the cylinder collapses longitudinally, and takes a twisted or spiral form, and then it bursts the boll. When mature it is like a twisted ribbon or shaving, a little thicker at the edges than in the centre, and pointed at the end. The fibres adhere to each other because the convolutions interlock, and *not* because of any barb or beard. A very common impression exists that there is such a barb or hook on the fibres, but this is an error.

Now, it must be apparent that to draw such a delicate fibre between wires, by means of the teeth of a saw, must impair the elasticity and form of the fibre. It certainly does injure it, sometimes very greatly, and there can be no way of avoiding this difficulty with the use of the saw: it is inherent in the nature of the gin itself, whose only merit is the quantity of work that it will do, and the rough treatment the machine itself will endure without being rendered absolutely useless.

I therefore suggest as the subject of importance:—

1. *Improvements in ginning.*

In this connection I beg to advise a special investigation of the

roller gin of Messrs. Platt Brothers & Co., of Oldham, Eng., whose machine I have reason to believe has been made capable of yielding quantity equal to the saw gin in proportion to the power and labor applied, and delivering the fibre in better condition than any saw gin can be made to do; and also the roller gin of Dobson & Barlow of England.

2. *Trash-cleaners.*

Second in importance to the right mode of ginning is the removal of trash from the fibre.

In the long run it cannot be profitable to sell dirty cotton if it can be made clean before it leaves the place of production. It is often alleged that it does not pay to make clean cotton, but the producers may rest assured that the time to sell trash for cotton has gone by, and that quality will now tell.

In these days of close economy, when the profit of every business depends on the most minute savings at every point, the man who makes the best and cleanest cotton will surely get the highest price, and one that will pay for the care used. Hence the simplest and readiest methods of removing dust, leaf, and other trash, become of vital importance. One machine has been brought to the attention of Northern manufacturers, which seems to be based upon a true principle, to wit: that the time to remove dirt from the fibre is before the cotton is ginned, and not after. If seed-cotton is subjected to the action of a beater before the fibre is detached, the weight of the seed is sufficient to carry the fibre away from the light particles of dust, leaf, and other trash, which fall behind. This we understand to be the principle of the "Ralston Cotton Cleaner," now in use in the neighborhood of Brenham, Tex., and elsewhere.

I therefore suggest the subject of trash-cleaners, and I beg to state that there is no branch of the cotton manufacture more important than the treatment of the fibre, from the picking to the bailing inclusive, none in which there is so much waste and bad work caused by unsuitable machinery, and none in which there is so great a chance for fortunes to be made in new inventions and their application.

We have secured almost an absolute control of the production of cotton, and in order to make this control complete and permanent we need to apply every possible method of improvement.

In this connection it may be added that in the long run the man who treats his cotton as carefully as he would a bale of cotton cloth, who packs it in the half or quarter bales, wired and covered with light burlap, will make the most money. Such method would imply smaller and more compact presses on the farms, with easier handling, more careful storage, and protection of cotton in the bale, easier loading and unloading, and therefore cheaper transportation.

3. Cotton-seed.

I trust it may not be considered presumptuous in one who only knows the growth of cotton from observation and not from any practical experience, to say that few of the cotton-growers appear to have a true appreciation of the value of cotton-seed, or of the right method of using it, and it may not be officious for me to call attention to the details of this question.

In 1861, writing upon the subject of "Cheap Cotton by Free Labor," I said that if a variety of the cotton-plant could be found that would grow in a northern climate, producing only seed, but without fibre, it would be one of the most valuable northern crops. The progress made in the use of seed in late years has fully confirmed me in this conviction.

The full value of the seed appears to be even yet but little understood. The fibre of the cotton takes almost nothing from the soil: it is chiefly carbon; but the seed belonging to each bale takes from the soil nearly fifty pounds of mineral element, chiefly phosphates of lime and potash. If this were properly treated, the cotton-field would become richer every year. Tht hull and kernel would be separated, the hull used for tanning or for paper-stock, probably for the latter purpose, as it is easily converted into most excellent pulp.

The oil would be extracted from the kernel, and the meal would be fed to sheep folded upon the cotton-field; thus the crop of cotton would be increased, as the manure from animals fed on cotton-seed meal or hulls is richer than any other, and the wool-clip would be added. If the hulls are not too valuable for other purposes, they either should be fed to stock separately or be ground with the cotton-seed meal, as much of the mineral elements drawn from the soil is in the hull as well as in the kernel.

The spiked wire fence now gives a cheap and easy method of enclosing land; a small interest given to the colored laborers who care for the sheep will protect them; and, as dogs prefer dead meat to live mutton, a few bits of coarse meat, previously treated with a little strychnine, soon causes dogs to become indisposed to eat mutton. The barbed wire fence is now made dog-proof, and four hundred acres can be surrounded by it and divided by it into four fields of a hundred acres each at a cost of less than one thousand dollars.

The latest treatment of cotton-seed kernel is to leach it with naphtha, by which method ten to fifteen per cent more oil is extracted than can be had by pressing; the naphtha is distilled off to be used again, and the kernel is then treated with superheated steam, which leaves it a perfectly dry, sweet, nutritious, and digestible food for animals. It is alleged that in France methods have been discovered for procuring a valuable blue dyestuff from cotton-seed.

The right treatment of cotton-seed and its products may well precede attempts to manufacture cotton goods in the cotton states. It is a branch of work only just begun; and an enormous expenditure now made for the purpose of commercial fertilizers may be saved if this great source of wealth be converted to its true use.

Until the hulls of cotton-seed are proved to be too valuable for such a purpose, the most suitable use of them would be as feed for stock. They contain a large portion of the mineral element drawn from the soil. Cattle eat them with avidity, and if the lint is properly removed they are more fit to mix with cotton-seed meal than either cut hay or chopped straw.

At the price at which I have been informed that hulls can be bought, they would pay well to move a considerable distance for feed for stock, and the manure from cattle or sheep fed upon them would be as rich as from cotton-seed meal. Cotton-seed hulls are also said to be the best material for packing the axle-boxes of railroad-cars, being cheaper and better than cotton-thread waste.

I beg to suggest a fourth subject: —

The rotation of cotton and wool husbandry on the same field, and the right use of cotton-seed.

Two to three million tons of material which can be converted by cheap and simple methods, with very little waste, into rich and nutritious food, oil, potash, soap, tannic acid, and paper-stock, constitutes by itself a crop of vast utility and value; and, at the risk of being considered rash, I venture to predict that the time is not far distant when the value of the crop of cotton-seed will be from one-half to three-quarters the value of the crop of cotton-fibre.

With such prizes within reach, and requiring but a small investment of capital compared to the amount needed for the complex machinery of the great factories that come later, and are more fit for a dense population, we are led to the next subject of importance: the right construction and mechanism of the gin-stand.

If the writer can judge correctly from many indications, the present construction of the buildings for and the application of power to cotton-gins leave room for great improvement.

The danger of fire seems to be great; and the work done calls for such methods of construction, and such apparatus for the extinction of fires, as have made the opening and picking departments of Northern factories very safe and permanent. I beg to send you a section and plan of a building of suitable kind, which should be protected by the automatic sprinkler, by means of which a fire lets on its own water, puts itself out, and sounds its own alarm.

Subject five would therefore be: —

The right construction of gin-houses and gin-stands, and the means of preventing fires therein.

Lastly, I take the liberty of suggesting that a very essential element in the future prosperity of the cotton-grower and the cotton-manufacturer is a more intimate acquaintance with each other.

The people of this country were divided for a century into two sections; the cause of the division was slavery. That cause has been removed, and the attempts of partisan leaders to keep up a sectional division after the removal of the cause would only excite a smile of derision if it did not make mischief for the time being. The incapable men who now assume to live upon the dead issues of the past must soon give place to greater men, who will be the exponents of the great questions of the present.

These great questions are the preservation of local self-government (let me not be misunderstood: I do not refer to the pernicious doctrine of State sovereignty, so called, but to that form of local self-government which finds its most democratic expression in the town meeting of New England), the questions of State and National taxation, the money question, and all the other great problems that are pressing for solution; questions which affect all alike, without regard to section, and which are retarded in their settlement by all sectional agitation.

Great industrial forces are working in the South as well as North; the whole structure of society is changing; old things have passed away, new men and new measures are forcing their way to the front.

Men who live in the North need more intimate acquaintance with men and things at the South.

Men at the South need to know the methods of economy that make the North rich and prosperous, and to learn that all that we have gained in wealth is but the saving of the waste that used to be made before we were forced by necessity to devise the right method of saving.

When the cotton-manufacture is established in the minds of those who control it as *one* undertaking, and not *two;* when the fact is recognized that the most important department of this manufacture begins at the gin-stand on the Southern field, and that it is one process until it ends in the cloth-room of the Northern factory; that throughout its course it calls for close acquaintance, for skill of like kind, and for methods of saving that inure to the profit of each and all, — then all divisions of section or interest in this branch of industry will disappear, and, if Cotton be king at all, he will be king over a united kingdom.

My last suggestion, therefore, is that your annual meeting shall consider

: *union of the cotton kingdom*,
shall send its best representatives to our Northern department of
kingdom to see what measures are needed to secure a true repre-
ation in the government of the nation, to the end that the coun-
of this kingdom shall no longer be divided.

EDWARD ATKINSON.

[No. 29.]

N. E. COTTON MANUFACTURERS' ASSOCIATION.

PROCEEDINGS

OF THE

SEMI-ANNUAL MEETING,

HELD AT BOSTON, OCTOBER 27, 1880.

BOSTON:
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1881.

CALL FOR MEETING.

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION,
BOSTON, Oct. 1, 1880.

DEAR SIR, — The stated Semi-Annual Meeting of the Association will be held at the Massachusetts Institute of Technology, Boylston Street, Boston, on Wednesday, Oct. 27, 1880, at ten o'clock A.M., with an afternoon session beginning at two o'clock.

Topics heretofore discussed will still be in order if called up by any member; and, in addition, the Board have the pleasure to announce the following: —

J. H. SAWYER, Esq., of Lowell, Mass., will present a paper on the subject of Carding.

WALTER E. PARKER, Esq., of Woonsocket, R.I., will present the topic of the Combustion of Fuel, with relation to the use of different sizes of coal.

It is hoped that members familiar with the above subjects will pursue the discussions thus opened, giving the results of their own investigations.

The Board request that any members familiar with the comparative merits of iron and steel shafting, will give the results of their use of each.

An early and full attendance is invited.

By order of the Board of Government.

AMBROSE EASTMAN, *Secretary.*

PROCEEDINGS.

THE stated semi-annual meeting of the New England Cotton Manufacturers' Association was held at the Massachusetts Institute of Technology, Boston, on Wednesday, Oct. 27, 1880, commencing at ten o'clock A.M.

Vice-President WILLIAM E. GOULDING, Esq., occupied the chair, and, after calling the meeting to order, said: —

The CHAIRMAN. As it is customary to vote upon propositions for new membership at this point, I would call your attention, by request, to the qualifications of membership in this institution. This subject has been talked of once or twice in the Board of Government, and it is suggested that several of those who were presented for membership did not understand the qualifications. I will therefore read the article which defines those qualifications (reads Art. 8 of the By-Laws as follows): —

ARTICLE 8. Any person of good moral character, who now is, or hereafter may be, Treasurer, Agent, or Superintendent of any Cotton Mill, may become a member of this Association, upon his signing the By-Laws and paying an admission fee of Ten Dollars, and an annual assessment not exceeding Ten Dollars. After the first meeting of the Association, and at any regular meeting thereafter, new members may be admitted upon the nomination of any member, he obtaining a majority of votes of the members present. Any member may withdraw from the Association at any regular meeting, upon payment of all arrearages, first giving notice of his intention so to do, to the Secretary; and any member may be expelled *for cause*, at any regular meeting, two-thirds of the members present voting therefor.

The Secretary will now read the names of those proposed for membership.

The following named gentlemen were then proposed, and duly elected members of the Association: —

ALEXANDER G. BROWN, Williamstown, Mass.
THOMAS C. CHANDLER, Willimantic, Conn.
D. E. CONVERSE, Glendale, S.C.
F. S. DROWN, Pawtucket, R.I.
J. F. HANSON, Macon, Ga.
THOMAS J. LEIPER, Chester, Penn.
HENRY M. LOVERING, Taunton, Mass.
THOMAS MAYOR, Providence, R.I.
W. E. McCOY, Augusta, Ga.
CHARLES S. NELSON, Victoryville, N.Y.
THOMAS F. PLUNKETT, North Manchester, Conn.
ROBERT L. STEELE, Great Falls, N.C.
GEORGE P. TAYLOR, Clinton, Mass.

The following gentlemen, on their own request, were granted leave to withdraw from the Association, having qualified themselves to do so by compliance with the rules: A. R. FIELD, Lawrence, Mass.; EBEN WRIGHT, Boston, Mass.

J. H. SAWYER, Esq., of Lowell, Mass., then read the following paper on the subject of "Carding": —

CARDS AND CARDING.

BY J. H. SAWYER, ESQ., LOWELL, MASS.

I SHALL ask your attention, in the following order, to some of the questions relating to the subject of carding: —

1. The kind of card to be used.
2. The number of cards required.
3. The question of double or single carding.
4. Some minor questions relating to draught, weight of laps, and speeds.

THE KIND OF CARD TO BE USED.

Evidently no kind of card should be used which is incapable of doing a class of work suited to the goods that are to be made. No advantage of cost of plant, economy of room, or expense of operation, should be allowed to outweigh this prime requirement; but the question of cost is of great importance, and may be conveniently considered at the outset.

We can, perhaps, most readily approach this branch of the subject by estimating the outlay required, and the expense of operation, in a mill designed to produce a given amount of yarn of some medium number. As an illustration, we will suppose that it is desired to make six thousand pounds per day of No. 25 yarn, for unbleached cloth, and that the kind of card to be used is to be chosen from the following: —

1st, The common American top-flat card with Wellman stripper. 2d, The Foss & Pevey under-flat card. 3d, Cards combining flats with workers and strippers, and known as union or combination cards.

I do not include the full roller-card in this list, because I do not suppose that the quality of work done by it would compare favorably with that done by those named in the list.

It is claimed by the advocates of these various systems, that the work specified can be satisfactorily done with two hundred and forty (240) top-flat cards, arranged for double carding, at fifty pounds per day for each pair, consisting of one breaker and

one finisher: one hundred and thirty-two (132) under-flat cards arranged for single carding, at the rate of forty-five and a half pounds each per day: one hundred and twelve (112) Whitin combination cards at fifty-four pounds each per day; seventy-two (72) English combination cards with cylinder forty-five inches in diameter, and forty inches wide, at eighty-three and a half pounds each per day, and united in sections by railways.

The cost of the various systems, including cards, card-clothing, lap and railway-heads, troughs, shafting, belting, floor space, and plant for motive power, would be about as follows:—

240 top-flat cards	$70,800 00
132 under-flat cards	56,500 00
112 Whitin combination cards	54,500 00
72 English combination cards	52,000 00

The daily expenses of operating, including labor, estimated from the best data at my command, with power at fifty dollars per year for horse-power, interest on the investment at six per cent, and repairs and renewals at six per cent, would be for

240 top-flat cards	$52 10
132 under-flat cards	38 30
112 Whitin combination cards	38 60
72 English combination cards	37 90

or about eight and two-thirds mills per pound for the top-flat cards, and about six and one-third mills for each of the other kinds.

The cost of labor forms less than thirty per cent of the entire cost per day in any of the preceding estimates, and the interest on the investment and the allowance for depreciation form in every case more than fifty per cent; hence improvements in this class of machinery, which tend to reduce the cost of the plant, are of more importance than those which merely aim to lessen the cost of labor.

The relative importance of the items forming the cost of these different systems is not the same in all cases. In some cases the amount of room available may be the controlling element, in others the cost of power or labor, and in others the amount of invested capital. It would be impossible, at this time, to consider all the varying circumstances.

The amount of strippings and flyings removed from ordinary top-flat cards, when arranged for double carding, is probably about nine per cent, and from under-flat cards about seven per cent, the chief difference being in the amount of flyings from under the cylinder. The statements in regard to roller-carding, embodied in the report of the meeting of this Association, held in April, 1877, show a loss of from one and one-half to three per cent. The net loss from waste, on any cards, is reduced by the value of that which is removed. If the nine per cent of waste, estimated as made on top-flat cards, can be sold or used so as to be worth two-thirds of its cost, the net loss with this system will be reduced to three per cent. The same disposition of waste on under-flat cards would reduce the loss to two and one-third per cent. I have no data respecting the waste on combination cards, but I estimate the net loss at not over two per cent. If we credit to the roller-card the value of its waste, the net loss on this system will still be not much less than on the other systems, but the advantage of removing the waste by means of flats, where they are used, will be great in comparison. Mote collectors, many modifications of which exist, are efficient devices for removing fine leaf from the work. It would seem that without something of this kind a large number of flats are necessary for securing clean work. I do not know to what extent they can be substituted for flats.

The flat card is most generally used in this country, and on all grades of work. Roller-cards are used in England for export goods, for low numbers for the home trade, and for printing cloths. Top-flat cards, or combination cards, are used in England for fine numbers for the home trade.

We ought not to shut our eyes to the fact that systems of carding, which differ from that most commonly approved in this country, are claimed to do good work at two-thirds the cost of the ordinary method. If the more expensive system is capable of saving its extra cost in quality of stock used, or in value of work done, it will still hold its own, but not otherwise.

THE NUMBER OF CARDS REQUIRED.

The amount of work done per card varies greatly in different mills. The average quantities for various numbers of yarn, using top-flat cards, arranged for double carding, is probably

about as follows for each pair of cards, consisting of one breaker and one finisher: —

	POUNDS.
No. 14	65
16	60
20	54
25	50
30	45
36	40
42	38
50	35

It is an interesting coincidence that these quantities correspond very nearly with the quotients obtained by dividing 240 by the square roots of the numbers of yarn; or, in other words, they vary inversely as the square roots of the numbers.

In the following table the first column contains numbers of yarn, the second the square roots of the numbers, the third the quotients obtained by dividing 240 by the square roots of the numbers, and the last column the quantities ordinarily carded on top-flat cards arranged for double carding: — .

Numbers of Yarn.	Square roots of numbers of yarn.	240 divided by the square roots of the numbers of yarn.	Quantities ordinarily carded on top-flat cards arranged for double carding.
14	3.74	64.0	65.
16	4.00	60.0	60.
20	4.47	53 6	54.
25	5.00	48.0	50.
30	5.48	43.8	45.
36	6.00	40 0	40.
42	6.48	37.0	38.
50	7.07	33.9	35.

It will be seen that the numbers in the last two columns substantially agree. Extending this rule to higher numbers, and substituting one process of carding, followed by combing, in

place of double carding, we should have as the proportionate amounts: —

30	pounds	for	No. 64
27	"	"	" 81
24	"	"	" 100
20	"	"	" 150
17	"	"	" 200

I suppose that we cannot explain this rule on any mathematical principle, but that its coincidence with the average practice is due to the obvious propriety of decreasing the amounts carded less rapidly than the reduction in the weight of the yarn.

It is obviously less expensive for a mill, having a given number of spindles on fine yarns, to decrease the quantity done per card a given percentage below the quantities which have been named, than for a mill on coarse yarns to make a similar percentage of reduction. For example, suppose a mill of forty thousand spindles, on No. 13 yarn, were to decrease the work done per card by ten per cent below the amount given in the table, there would be required an addition of about thirty cards, while a mill of the same number of spindles on No. 50 yarn could make a corresponding reduction of ten per cent by adding only eight cards. For this reason, the tendency to overcrowd on coarse work is much greater than on fine work, not only in arranging new mills, but in adding spindles and looms in those already established.

DOUBLE OR SINGLE CARDING.

The proper way to approach this branch of the subject is to consider which system will, with a given number of cards of a given kind, produce the best result. We ought not to compare eighty cards arranged on one system with one hundred of the same kind arranged on the other. We shall simplify the discussion, if, for the present, we confine our attention to the ordinary thirty-six inch top-flat card. With one hundred cards, on which it is required to produce twenty-five hundred pounds per day, shall we put twenty-five pounds through each card, or shall we divide the cards into breakers and finishers, and put fifty pounds through each?

The cost of labor in the card-room will probably be less with the single than with the double system, but the only legitimate

saving will be the cost of making the laps on the lap-head, and of transporting them from the breaker to the finisher cards. This labor can be done for less than half a mill a pound, more or less of which will be offset by the advantage of greater concentration of railway-heads on the double system. A greater saving than this sometimes appears to result from the single process, when, as compared with the double system, fewer cards are used, and a less number of grinders, strippers, &c., are employed, but such a saving does not result from the system employed, but from the diminution in number of cards used.

More ends will be united at the railway-head, to form a sliver of a given weight, with the single than with the double process. If the weight of sliver taken from the doffer were reduced in proportion to the amount carded, the number would be doubled. It is, however, impracticable to make the card-sliver hold together if greatly reduced in weight, and the reduction in product is obtained partly by reducing the weight of the sliver, and partly by reducing the speed of the doffer. The number of ends to each railway-head is therefore, with a given kind of card, usually somewhat larger for the single than for the double process, and the stopping of one card in a section is a less evil in the former than in the latter system.

The carding action between the teeth of the card is probably better with a thin sheet in single, than with a thick sheet in double, carding, and it is probably true that the wear and tear of card-clothing will be less in the single than in the double process.

An evil, the magnitude of which depends on the amount of care used in keeping the slivers in the breaker railway-troughs so distributed as to make a sheet of uniform thickness, results from the double process. So far as the action of the card is concerned, it is a greater evil to feed it with a striped lap, such as will be made when the ends from the breaker cards are not properly distributed in the troughs, than from a lap which varies in thickness in spots and irregularly, as the laps from pickers are liable to do. When a striped lap is fed to a card, the limit of good work is the amount that can be done where the lap is thickest, and not the average weight of the lap. The cylinder and tops of a card which has been fed with a striped lap soon become loaded in stripes, and, if the irregularity is great, nits will be formed at the thick places, and the teeth will be so

heavily filled as to prevent them from performing the office for which they are intended.

It is generally admitted that stronger yarn is made by the single than the double process. Such a result may possibly be due to the lesser number of teeth which act upon the fibres of cotton in the single than in the double process. The number of teeth which act upon a fibre in its passage through the card does not depend on the amount carded in pounds, but upon the area of carding-surface, and the number of times that the fibres pass by it. Increasing the number of teeth doubtless increases the breaking and tearing of the fibres, as well as elongates their natural spirals. The fibres are probably elongated in the carding process much as a shaving is lengthened by pulling on its two ends; in which operation we do not reduce the number of twists in the entire shaving, but we do reduce the number per inch. Many who admit that single-carded yarn is stronger than double-carded, will still say that the latter will run better in the weaving-room. I am not aware that experiments have been made in which all disturbing causes have been removed, so as to conclusively settle this question of strength.

Better mixing of staple is secured by the double than the single process; and it is not a sufficient answer to the objection to single carding, on this account, to say that the required mixing can be secured at the drawing-frame, or at the picker: the real question is, what is the best that can be done by the cards?

A probable greater uniformity of linear weight of sliver from the railway-head can be secured by the double than by the single system; for although, as has been previously stated, a less number of strands will usually be united in the former than in the latter process, it is probable that the advantages of using a lap on the finisher cards made from a large number of breaker card-slivers, will over-balance the advantages resulting from more strands in the railway-trough.

The fibres will be passed between a greater number of teeth in double than in single carding, and reducing the amount put through the card will not offset the advantage gained by increasing the carding-surface. The double system affords an opportunity not offered by the single system for correcting imperfections in the work which arise from faults in the condition of the cards. More strippings will be made on the double than the single process; but the former system divides the waste into

DRAUGHT IN CARDS.

No such law as that which limits the amount of draught between the rolls of a drawing or spinning frame prevents the employment of large draughts on cards. Drawing between rolls is an *unevening* process; we employ it as the best known means of reducing the size of the sliver, and of getting the fibres straight and parallel. The sliver produced by drawing-rolls can be more uniform in size than that with which the rolls are supplied only when doubling occurs in connection with the drawing. Experience has shown that large draughts between rolls are impracticable on account of this tendency to unevenness; but the only limit to the amount of draught on cards is that which is fixed on one side by the weight of the lap that can be advantageously used, and on the other by the weight of the sliver that can be conveniently handled.

Picker-laps vary from about eight to fourteen ounces per yard, and the slivers, from doffers, from forty to one hundred grains per yard, with occasional exceptions on either side. The heavier lap, if made into the lighter sliver, would require a draught of one hundred and fifty-three, and the lighter lap, if made into the heavier sliver, a draught of thirty-five.

It is claimed that a thick lap fed slowly is better than a thin lap fed rapidly, because the fibres in a thick lap will receive a greater number of blows from the teeth in the cylinder than those in a thin sheet; but the weight of the lap is limited by the capacity of the perforated cylinders of the picker to collect an even sheet, and by the capacity of the feed-rolls of the card to so hold the lap as to prevent its being drawn into the card in bunches. The most common weight of picker-lap is about ten ounces per yard. The draught on cards, when united by railways, chiefly depends on the number that are so united. On breaker cards it is generally about equal to the doublings; but the weight of lap made at the lap-head is somewhat lighter than the picker-lap, on account of the strippings, &c., in the card.

On single carding, and on finisher cards used in double carding, the draught further depends on the weight of sliver which it is desired to make at the railway-heads. With a nine-ounce lap and a draught of seventy-eight on the card, the sliver will weigh forty-eight grains per yard, and this, with ten cards united in a section, and a draught of four and one-half in the

railway-head, will give a railway-sliver weighing about one hundred and six grains per yard. Other things being equal, a large draught on the card requires a high speed of doffer, and produces a light sliver from the doffer.

The carding action between the cylinder and doffer is doubtless more efficient with a light than with a heavy sliver; but with short-stapled cotton, the sheet will not hold together if greatly reduced in weight. A high speed of doffer makes a correspondingly high speed of railway-rolls necessary, but here, also, a high speed is better than a heavy sliver. It is probably better to run the front rolls of railway-heads five hundred revolutions per minute with a sliver weighing one hundred grains per yard, than to run them at four hundred revolutions with a sliver weighing one hundred and twenty-five grains per yard.

SPEED OF CYLINDERS.

The surface speed of a card-cylinder, thirty-six inches in diameter, when making one hundred and thirty revolutions per minute, is about twelve hundred feet, and of a cylinder forty-five inches in diameter, when making one hundred and forty revolutions, about sixteen hundred feet. The former speed is most usual in this country, and the latter in England. These speeds are about forty times as great as those of the doffers: hence it follows that the gauzy film which envelops the under side of the doffer, is about forty times as heavy as that which is removed from the cylinder. When, therefore, the sliver from the doffer weighs forty grains per yard, that from the cylinder cannot much exceed one grain per yard. This film is so light that the difference in the appearance of the cylinder before and after it has taken its load at the feed-rolls is scarcely perceptible. The quantity of work done by the cards depends entirely on the weight of the lap and the speed of the feed-rolls. It in no way depends on the speed of the cylinder or of the doffer.

The cylinder carries the load from one side of the card to the other in a thinner or thicker sheet, depending on its speed; but the amount delivered by it to the doffer per minute is independent of its speed. Changing the speed of the cylinder will change the thickness of the load, but it will not change the number of teeth between which a given fibre of cotton will

pass, while going from one side of the card to the other. The speed of the cylinder should evidently be sufficiently high to so reduce the thickness of the film which it carries that every fibre shall, while passing through the card, be exposed to the action of the teeth; but, when this has been accomplished, there is probably little advantage, so far as the action of the teeth is concerned, in still further increasing the speed.

The centrifugal force, which tends to throw heavy foreign matter into the flats, increases with the speed; but the higher the speed of the cylinder, the greater will be the tendency of its clothing to bulge out, when running, and come in contact with that of the tops; the greater will be the amount of flyings at the ends of, and beneath, the cylinder; the greater the gatherings between the tops when they are raised for stripping; the greater the power required; and the greater the evils resulting from imperfectly balanced cylinders.

Experiments which have been made with thirty-six inch cylinders, running faster than one hundred and thirty revolutions per minute, have, so far as I know, failed to show any gain in the quality of the work, sufficient to compensate for the disadvantages attending the increased speed.

He would be a rash man who should appear in this place, to speak on the subject of carding, expecting to agree in every respect with all who were present. If I have succeeded in so presenting the subject as to secure an expression of their opinions from the members of the Association, I shall have performed the part assigned me by the Board of Government.

Mr. SAWYER. Professor Whitaker has prepared a series of charts which represent the various steps of flat carding, which he is ready to present to the Association, if they desire to have him do so.

A vote was passed requesting Professor Whitaker to exhibit his charts at this point, and they were shown by him accordingly.

Professor WHITAKER also read a paper on the subject, prefacing it as follows: —

What I shall have to say will have to do with some progressive steps in the invention and improvement of the flat card; and, if it is in order, I should like, not to take a comprehensive and world-wide view of the subject, but simply to state some

facts which have become known to me during ten years' residence in Lowell, or through my friends, who are, or have been, manufacturers. Excuse me if I should omit in this short account any steps which are well known to others.

Professor WHITAKER then proceeded to read his paper, as follows: —

MR. PRESIDENT, — The system of *flat* carding has been quite a favorite one with American carders.

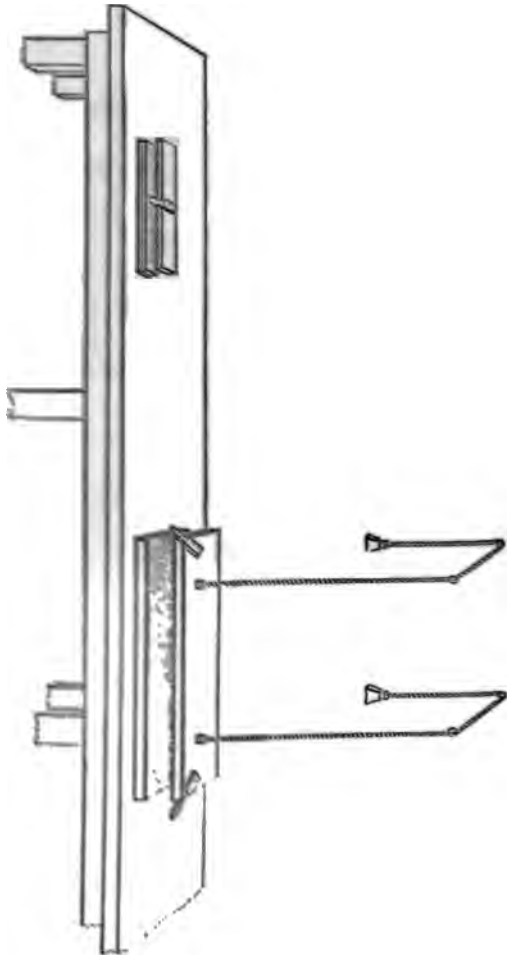
I have been much interested in noting some progressive steps in the Invention and Improvement of the Flat Card. I shall not undertake a comprehensive, world-wide view of the subject, but shall merely state some facts that have become known to me during a ten years' residence in Lowell, or through my friends who are, or who have been, connected with manufactories. I beg that you will excuse me if I should omit to mention, in this short account, many steps in this progression, which are well known to others. I am indebted to Mr. Evan Leigh for information and an illustration from his "Science of Modern Cotton-Spinning." Also to Mr. William A. Burke, treasurer of the Lowell Machine Shop, for permission to use at this meeting drawings of cards built at different dates by that corporation. If most of my illustrations are of Lowell cards, I hope you will excuse it, as those illustrations were most easily accessible to me. The diagrams which I have had prepared are intended for use at this meeting only.

The earliest account that we have of the carding process, is of two flats, one nailed to a bench, and the other having a single handle by which it could be moved back and forth over the fixed card, upon which the cotton was placed. (See Fig. 1.)

The first improvement was made by James Hargreaves of Blackburn. He suspended the movable flat by two cords which passed over pulleys, and which had weights at the other ends. (See Fig. 1.) These "Stock Cards," as they were called, had considerably larger flats than those before mentioned, and much more and better work could be done by their aid, with less labor. The movable flat had two handles, and the sliver produced was longer than before.

The second improvement was made by Lewis Paul of Birmingham in 1748. He attached the lower flat to a rotary

bench, that could be turned by a treadle movement about vertical shaft. While carding, the teeth of the lower f pointed *upward and from the operative.* When the carding h been completed, the lower flat was turned half-way around



teeth pointed *upward and towards the operative,* and it was venient to remove the carded cotton.

The third improvement was made by the same inventor, covered in the same patent. He substituted for the mo upper card a horizontal cylinder, which could be either rot or moved lengthwise, by hand. It was covered with longitu

strips of clothing, with longitudinal spaces between. The lower card was concaved to fit against the lower part of the cylinder. It could be moved lengthwise of a vertical shaft, and, also, turned about it. When carding, the concave could be brought close to the cylinder. When the carding was finished, the concave could be lowered and turned half-way about, to facilitate the removal of the cotton. (See Fig. 2.)

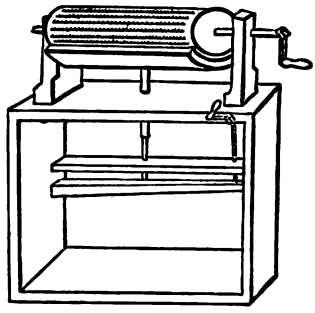


FIG. 2.

Hand Cylinder Card, by Lewis Paul of Birmingham. Third Improvement, 1748.

The next improvement, made about 1773, changed the carding process from an intermittent hand to a continuous power process. This change made its inventor, Richard Arkwright, very rich. It, with other inventions and his personal qualities, made him Sir Richard Arkwright. He fed the cotton to the cylinder by fluted rolls. He doffed the cotton from the cylinder by another smaller cylinder. He removed the cotton continuously from the doffer by the doffing comb. His power-card was as perfect a machine as the steam-power producer of his great contemporary, Watt.

Arkwright *completed the invention of the principal parts of the power-card.* The improvements which have since been made in it have been *improvements of particular details.* The essential features of his power-card were the same as those shown in that diagram which represents a card with twelve top-flats, covering .23 of the circumference. This card was for some time, previous to 1845, built by the Proprietors of the Locks and Canals on the Merrimac River, at their "big shop," as it was called, in Lowell. (See Fig. 3.)

The remainder of my remarks will relate to *progressive steps in the modification of the details of the flats.* In order that I

may be the more clearly understood, allow me to call attention to a point of detail in the setting of the flats. They are sometimes, but not commonly, so set that the toothed surface

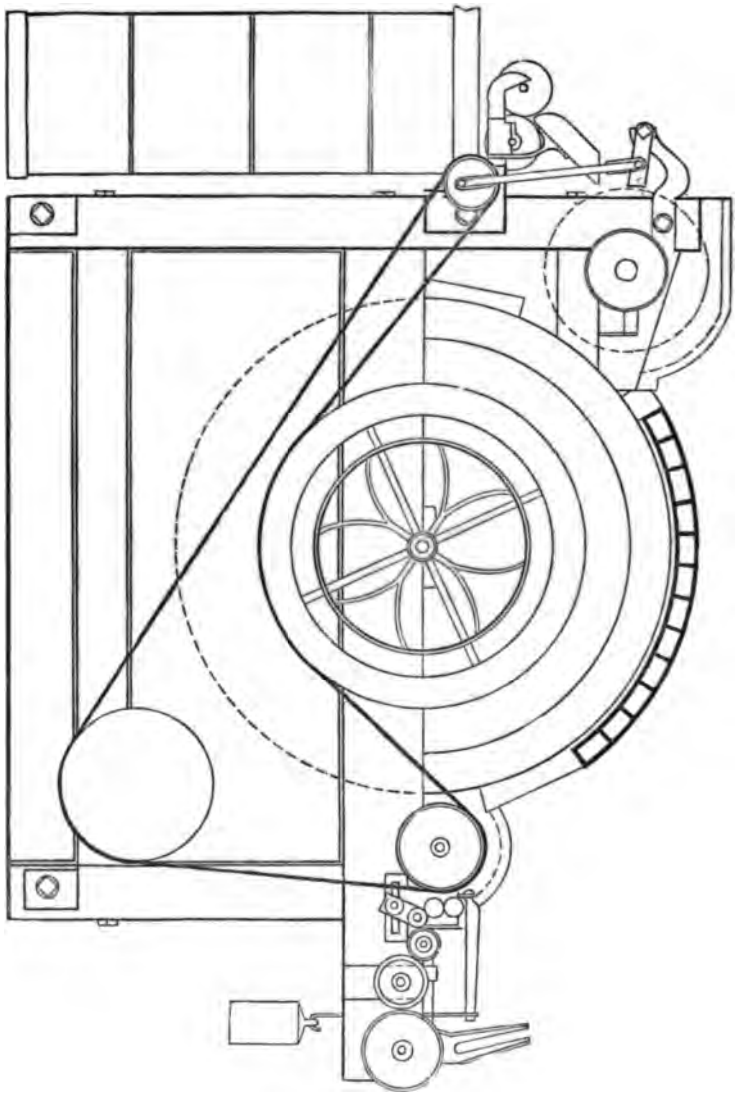


Fig. 3.

Built at Lowell until about 1845. 12 Top-flats occupy .23 of the circumference.

of the flat almost touches the corresponding surface of the cylinder along the centre line of the flat surface, as shown in the

sketch at C. (See Fig. 4.) They are more frequently set bevelling, so that either the front line of the flat, as at A, or the back line, as at B, almost touches the cylinder. Foster Wilson, a veteran carder, formerly of Lowell, but now of Hol-

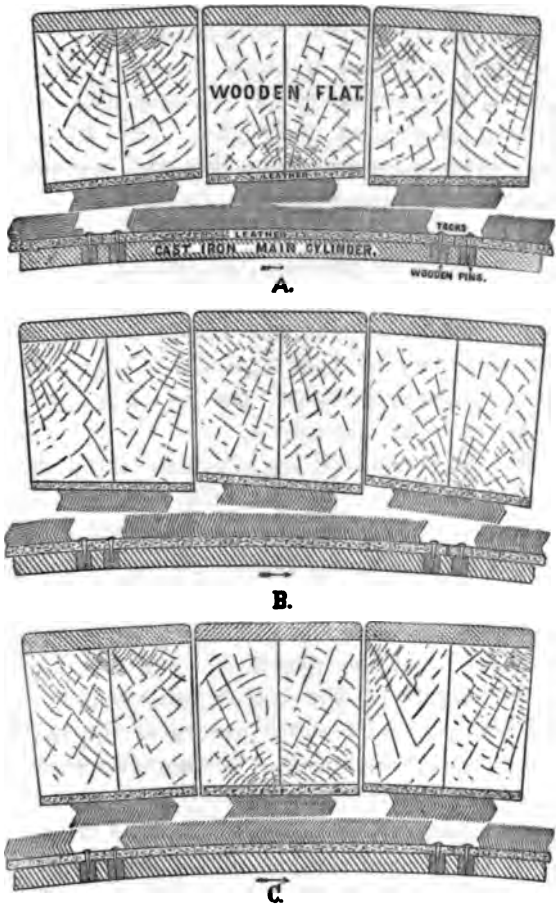


FIG. 4.

yoke, Mass., recommends, in his "Carder's Companion," that the front of the flat be set twice as far from the cylinder as the back is, as at B.[1]

Now, no matter which of these methods of setting the flats

[1] That edge of the toothed surface of the flat which the cotton meets first, is, in Mr. Wilson's work, called "the front." I have used the term in the same sense here.

is adopted, as the cotton fibre is, by the action of the cylinder-teeth, made to slide from flat to flat, it passes a succession of strictures, or "*bights*," with enlargements between. At each bight the movement of the cotton is checked, by the teeth of the flat, until it is teazed onward, fibre by fibre.

In flat carding, then, the cotton does not undergo a *single* process as it passes from the "feed-rolls" or the "licker-in" to the doffer, but *each time* it passes between the cylinder and a flat there is a *repetition* of the disentangling, straightening, parallel-laying process at the bight. The fibres enter each succeeding bight, more free from dirt and nep, and more thoroughly disentangled than before.

It has been supposed that to increase the number of these repetitions would be to increase the efficiency of the performance of the card. How many practical men have acted as if this supposition was correct, will appear from a consideration of the fact that *there has been a gradual but steady increase in the number of these repetitions.* Let us see if it *is* a fact that there has been such an increase.

About fifty years ago, as I am informed by Mr. Boyden of the Prescott Mills, in Lowell, the flat cards that were in use in Killingly, Conn., had but ten flats each. In 1839 Mr. William A. Burke started the Amoskeag Machine Shop at Manchester, and about 1841 he built some cards. The width of the toothed surface of the older flats was one and five-eighths inches, and the entire width of a flat was about two and a half inches, while the length of staple of the cotton most commonly used was much less. He decided that the process at the bight would be quite as well performed if the distance between two bights was reduced to correspond more nearly with the length of the staple; and he reduced the width of the flats to two inches, and the width of the toothed surface of the flat to an inch and a quarter. This change enabled him to increase the number of flats covering the same space in the proportion of two and a half to two, and to materially increase the efficiency of the card. The new cards had iron frames, and were otherwise improved.

In April, 1845, Mr. Burke took charge of the newly-incorporated Lowell Machine Shop, formerly owned by the Proprietors of the Locks and Canals. He soon brought out the iron frame card with fourteen flats covering .27 of the circumference. (See Fig. 5.)

Both this card, and its predecessor with twelve flats, delivered the sliver into tall cans placed beneath the doffer. (See Figs. 3 and 5.) The first railway-boxes that were built were lined within with smooth tin, had no belts, and were placed high up under the doffer. When the railway-boxes were placed near the floor, they occupied so much less height than the cans had done, that it became possible to drop the doffer down also. Space was thus afforded for the placing of more flats between

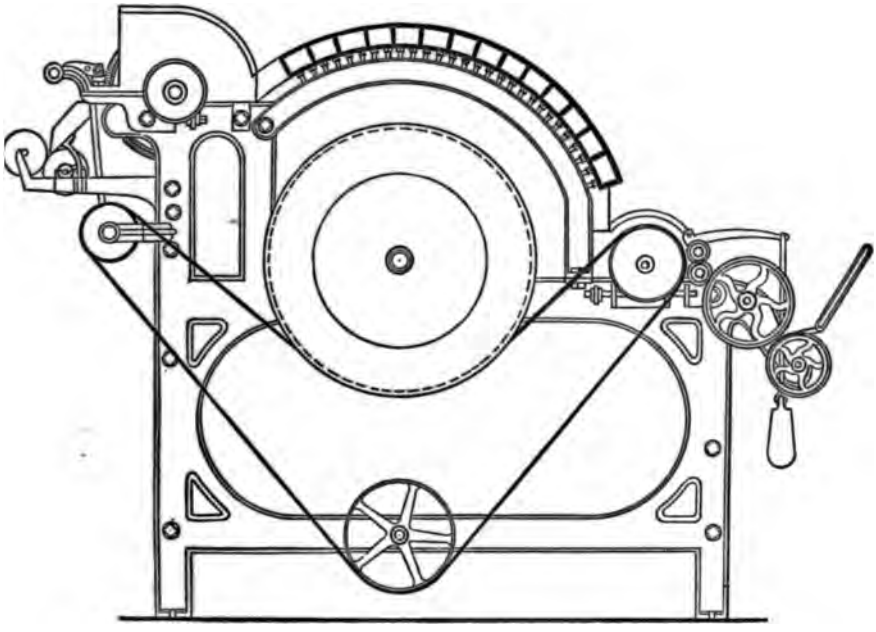


FIG. 5.

Built soon after 1845. 14 Top-flats occupy .27 of the circumference. Lowell Machine Shop.

those formerly used and the new position of the doffer. Just at what date this change was made I do not know; but the card, which was being built at Lowell in 1862, had a lowered doffer, with twenty flats, covering .35 of the circumference. (See Fig. 6.)

Several attempts have been made to increase the number of flats by increasing the diameter of the cylinder; but for various reasons these larger cylinders have not been favorably received, and have generally gone out of use.

The feed-rolls, flats, and doffer, in the Lowell card of 1862, occupied about one-half of the circumference. The other half was not utilized to any important extent.

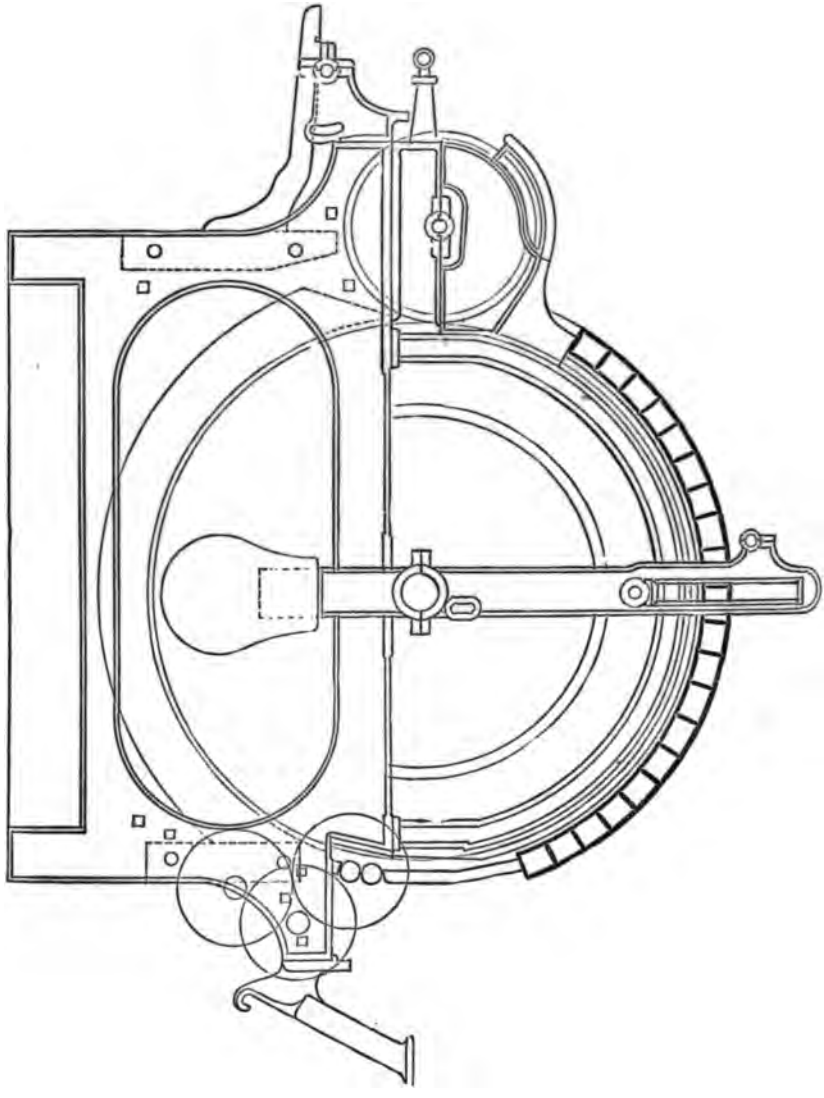


Fig. 6.

Built in 1862 at Lowell. 20 Top-flats occupy .35 of the circumference.

In 1874 or 1875, my old shopmate, Mr. Foss, to whom I was indebted for many valuable hints during my apprenticeship at the Lowell Machine Shop, conceived the idea of extending the

flats over a portion of this hitherto unproductive area. He carried the feed-rolls down under the card, and located them on the other side beneath the doffer. (See Fig. 7.) He reasoned that in making this change, he would not only increase the number of repetitions at the bights, but also utilize that portion of the

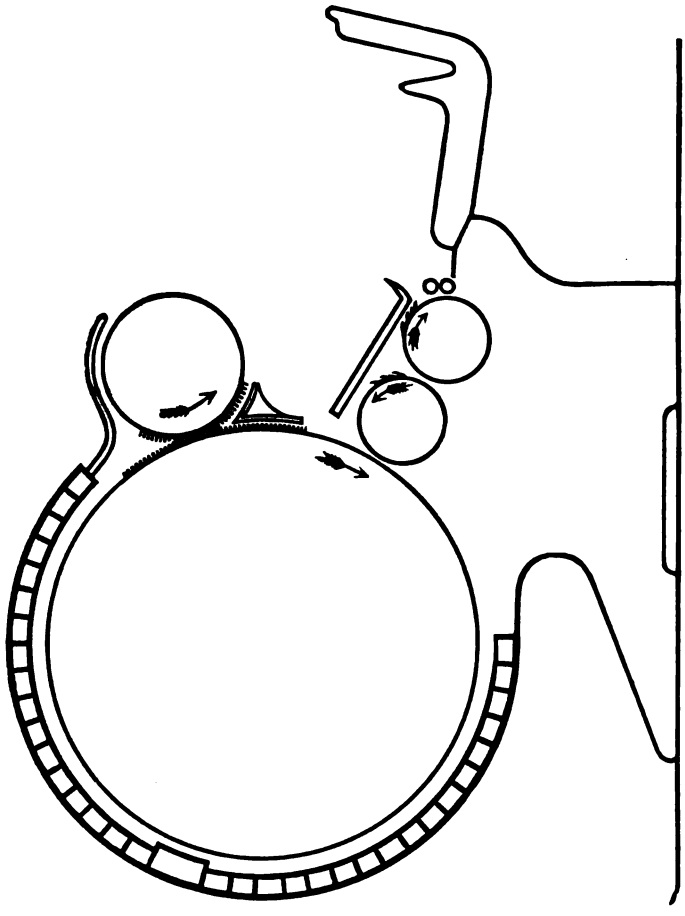


FIG. 7.
Built in 1880. 17 Top-flats and 17 Under-flats occupy .76 of the circumference. Lowell Machine Shop.

cylinder which was most valuable for the removal of heavy dirt; for, with under-flats, gravitation would *aid* centrifugal force in driving the dirt out between the flats, while with top-flats gravitation *opposes* the centrifugal force. Practical trial has shown that this reasoning was correct.

The CHAIRMAN. With these two papers and these charts before you, the very interesting subject of carding is now open for discussion, and we hope every member interested in that subject will take an active part in the discussion, without waiting for an invitation to do so. If no one volunteers, I will call upon Mr. Johnston of Cohoes, N.Y.

Mr. JOHNSTON. As I have been called upon, I suppose I shall have to make some reply, although I consider that there are older and wiser heads here, capable of interesting the Association more than I can. The subject is an important one. The author of the paper has given a good account of the history of carding, from its commencement to the present time. Probably some here are thoroughly committed to the subject of double carding. A new thing we like for its novelty, and we oftentimes go almost crazy after it, until we come to some objection. Until cards are worn out, until cards have to be reclothed and reset, until we have to work from the starting-point of a new card, in perfect order, with new clothing, we can hardly form a correct opinion as to what will be the practical result of such a machine. For ordinary numbers, with proper cleaning, I think that the single-card "workers and strippers" will, in the matter of expense, in the matter of room, in the matter of strength of yarn, be more satisfactory than double carding. We can card our cotton too much, as well as too little. I have in mind a circumstance, where, in changing one of our mills, we found it necessary to do additional work at one place, and keep more cotton coming from the other place, where we had large cards, "workers and strippers." We increased the work we were doing, for single carding, making No. 34 yarn, from eighty pounds to a card to one hundred and twenty pounds to a card, as breaks. We tested the yarn, where a Whitin card had been used,— the top-flat card, — and we found the yarn gave very much less satisfaction. It was a little cleaner and a little more even; yet the indications were that with ordinary cotton the yarn was very much weaker. I have said that weaving does not go as well with single carding as with double carding, yet tests will prove the yarn from single carding the strongest. Why is this? The reason is, that the strength of any thing is its weakest part. The goodness of yarn is that which it will stand, — not the good part, but the amount of bad there is in it. The goodness is determined by the little bad, and not by the

much good. Yarn may be to a considerable extent very perfect, and yet have places and imperfections in it which will kill all the good part of the work. I say with eighty pounds on a card, with "workers and strippers," the indication was that it was carded too much, and even a little too much with one hundred and twenty. With the ordinary amount on the single card, if we could clean our cotton properly, for yarn up to No. 30 single carding will always beat double; and, with the same stock, your goods will be just as bright, and oftentimes brighter, than from the double carding. That is my experience.

Now in relation to the waste from these cards. Certainly there is scarcely any fly-waste from the under top-card, and to pay two-thirds the price of cotton for flat waste, or cylinder strippings, may be good for the man that sells the stock, but I think it is usury to the man who buys it, not only seven per cent, but I think it is twenty-five per cent. Some people may think that if they buy cotton they have got cotton; but it is mighty poor stuff, with flat strippers, to make even No. 2 yarn. So we have waste to sell instead of goods. In reference to the question of economy, we must take into consideration what goes into the other different parts, and what into the wastage part. We must take into consideration what part we are going to sell. I should like to draw out some points from the gentlemen present, because, while carding itself may be old, yet I think there is a great deal to be learned about it. I think, in a cotton-mill, machines kept to their places will do their work, but a card is something that is to be worked at all the time. It may be right to-day, and go wrong of itself to-morrow.

The CHAIRMAN. I have been particularly interested in Mr. Johnston's remarks upon the value of waste, as we have to buy considerable. We almost always receive valuable suggestions from Mr. Garsed on these subjects. I hope he will not let this opportunity pass without our hearing from him. He shakes his head, which only shows that the gentlemen who opened the subject have thoroughly exhausted it.

We will now listen to a paper from Mr. Walter E. Parker of Woonsocket, R.I., who will discuss the subject of "the Combustion of Fuel, with Relation to the Use of Different Sizes of Coal."

Mr. PARKER then read his paper on the foregoing subject, as follows: —

COMBUSTION OF FUEL, WITH RELATION TO THE USE OF DIFFERENT SIZES OF COAL.

BY WALTER E. PARKER, ESQ., WOONSOCKET, R.I.

THE manufacturing industries of the United States of late years have been largely dependent upon steam as a motive power, while to-day considerably more than fifty per cent of the horse-powers employed are derived from the various kinds of fuel known in commerce. According to the census of 1870, the *cotton-mills* of New England employed or were furnished with 26,750 horse-powers of steam, and it is fair to say that the census of 1880 will show that steam is fast becoming the principal propelling power of the cotton-factories. Nearly all of the water-mills in operation to-day have outgrown the capacity of the water-power of the streams where they are located. The fuel we burn, therefore, for converting heat into mechanical power, the appliances experience has provided for generating and using steam, which is the receiver and conveyor of that power, are subjects looking toward economy, which are now justly receiving marked attention from our most eminent engineers, and all those who have to pay for fuel. We believe it an established fact, although not admitted by all, that, with proper combustion, American anthracite coal is the purest and best form of fuel available at the present time. Professor Rücker says in a recent work, "It is important that a fuel should not only supply a large amount of heat, but that it should supply it at a very high temperature." The duration of anthracite at high temperature, its long continued and uniform heat, and the consequent maintenance of a steady reliable steam-power, are points in its favor which cannot be said to be equalled by any other kind of fuel now in practical use in most of our manufactories. The use of anthracite, or hard lustrous coals, as a common fuel in America, is recent, only a few tons having been marketed in the year 1820. It was not liked at first, and not until it was discovered that furnaces properly constructed for burning wood and bituminous coal were unfit to a

greater or less extent for the best use of anthracite, did this coal come into favor; while now, in England and the Western States of America, anthracite is but little used, and bituminous coal is the common fuel.

If we concede the superiority of anthracite coal as a fuel, we come to the question, In what form and at what relative prices do you want it to insure best results? Here we may say that so long as the cost of fuel in the best equipped steam cotton-mills is from one-half cent to one cent per pound of goods produced, it is highly important that more care should be given to its purchase. All the coal beds, with few exceptions, are made up of various strata of pure coal, soft shale, slate, and other impure or earthy matter, and it is very probable that the unsuspecting purchaser, who says "coal is coal," will buy a goodly share of the poorer grades. It is said by those who have studied the composition of anthracite, that "coal which contains but eighty per cent of carbon and twenty per cent of ash, water, and other incombustible matter, is the lowest grade of commercial coal, and of little value." Certainly not, when we consider that in many localities the principal item of cost of fuel is the fee for transportation, which is the same for inferior as for first class steam-coals.

According to the tests made by Professor Johnson in 1844, for the United States Government, to ascertain the comparative value of American coals, he found that anthracite contained on an average,

90 per cent of	fixed carbon.
6.28 per cent of	earthy matter.
3.72 per cent of	hydrogen, oxygen, &c.

And with one pound he evaporated from eight to ten pounds of water in a cylinder boiler. At what pressure I am not able to state. This is mentioned to give an idea of the comparative value of the coal to be considered hereafter. The statements relating to the practical use of coal, which I am able to present to you to-day, are furnished by two mills of Woonsocket, R.I., which are run almost wholly by steam-power. The coal used by them for several years last past has been either grate or pea size, and the results to be given have been arrived at through patient, and, we hope, careful, attention to facts.

From the twenty-sixth day of April to the twentieth of September, 1880, inclusive, the Globe Mill used Scranton grate

coal. The amount bought was $890\frac{71}{100}$ tons of 2,200 pounds. The waste of handling and transportation was $14\frac{89}{100}$ tons, or $1\frac{67}{100}$ per cent, leaving $875\frac{82}{100}$ tons which were used. The total waste in combustion for any part of it was not determined, i.e., in a scientific way, but the waste of ash was found to be $10\frac{41}{100}$ per cent, and of clinker $2\frac{34}{100}$ per cent; total, $12\frac{3}{4}$ per cent.

The total cost based upon the average price in New York, for the time given, was $5.90 per ton, or $5,194\frac{84}{100}$. The mill was run $124\frac{1}{10}$ days, of 11 hours each, or 1,365 hours, and the average steam-power required was 620 horse-power, ascertained by a series of trials, running, through several weeks, with the Richard's Indicator. The above shows that one-horse power per hour was produced with $2\frac{38}{100}$ pounds of coal, which includes the full supply of steam to the slashers for drying yarn and boiling the sizing, the steaming of filling, and whatever steam was needed for the complete operation of the mill.

The boilers are 90 inch upright Corliss pattern, and the engine is a double cylinder geared 28″x60″ Corliss, run $\frac{1}{4}$ non-condensing. A common cylinder heater is used, which receives the feed water at an average temperature of 95°, and delivers it to the boilers at a temperature of 212° Fahrenheit. The Social Mill, from April 26 to Sept. 18, 1880, inclusive, was run $124\frac{44}{100}$ days, or 1,370 hours, and used $1,290\frac{83}{100}$ tons of Wilkesbarre, Scranton, and Philadelphia and Reading pea coal, which gave an average waste of ashes and clinkers in combustion of $15\frac{14}{100}$ per cent, the largest part of which were clinkers. The average steam-power used was $767\frac{73}{100}$ horse-power, ascertained by means of the indicator, cards having been taken each day since the first week in July, requiring, for the whole work of operating the mill, $2\frac{7}{10}$ pounds of coal per horse-power per hour. The total cost of the fuel, including $1\frac{1}{2}$ per cent for waste of transportation, &c., based upon the average price of washed pea coal in New York, for the time stated, was $5.05 per ton, or $6,616\frac{42}{100}$. Horizontal tubular boilers, and a double cylinder geared Corliss engine 30″x72″, run $\frac{1}{4}$ non-condensing, are used, and they have shown a lower rate per horse-power per hour than the Globe Mill, when both have been run with pea coal. The comparative cost, &c., of fuel, at the two mills, can be stated as follows: —

	Cost per Ton.	Lbs. per H.-P.	Cost per H.-P. per Hour.	Waste Ash and Clinkers.
Grate	$5 90	2.28	.00613	12.75%
Pea	$5 05	2.70	.00629	15.74%

Our conclusions as to the cause for the difference in the heat value of the two sizes used, have come through considerable experience, but we do not claim to have discovered any new principle or theory in the use of fuel. An eminent writer upon the subject of combustion has stated a principle which we indorse, "that an increase in the rapidity of combustion of any fuel is accompanied by a decrease in the evaporative efficiency."

Under similar conditions and work, small sizes are consumed more rapidly than larger-sized coals, and this, taken in connection with the liability of small coal to burn out in spots, calls for greater care of fires, and a more frequent supply of fuel. When a necessity for frequent firing exists, more air is admitted to the furnace than is needed, and heat is thus absorbed which might be transmitted to the water. Generally speaking, even washed pea coal is not so free from slate, dust, and earthy matter, as the larger sizes of anthracite.

The idea of using washed pea, pea and dust, bituminous coal and dust, &c., in large establishments in New England, is a recent one; and where such fuel is used in furnaces properly constructed for the combustion of anthracite grate and lump coal, the best results are not to be obtained: it is also not to be denied that recent improvements for the perfect combustion of poorer grades of fuel rely upon the use, to a certain extent, of the heat already generated.

The lower grades of coal are subject to greater and longer exposure to the action of the weather than the more merchantable sizes. Of the consequent loss of calorific value from such exposure there is no doubt, but with anthracite it is perhaps less than with any other form of fuel. Dr. Percy, in a recent publication, says of the "weathering of coal," that it "is due to the absorption of atmospheric oxygen, of which one portion combines with part of the carbon and part of the hydrogen of the coal, forming carbonic acid and water respectively, while another portion enters into an unknown state of combination

with the organic substance of the coal, and the remainder is consumed in oxidizing the iron pyrites which invariably exists in coal. The calorific power of the coal, and consequently its practical value, are thereby diminished; and when iron pyrites is present in considerable quantity, disintegration may take place to such an extent as to render coal comparatively worthless after long exposure to the atmosphere."

After giving in detail the methods adopted by several scientists for conducting experiments to determine the extent of loss, Dr. Percy concludes that the weathering of coal is of much interest in a practical point of view, and that when it is left at ordinary temperatures in contact with oxygen, either pure or as it exists in the atmosphere, it absorbs that gas, proportionately increasing its weight and decreasing its evaporative power. With the users of steam, however, the choice of fuel can only be made with certainty after they have tried the different coals in the precise conditions under which they are to be employed; and, without discussing the value of any particular boiler or method of generating steam, it may be said that the quantity of heat which can be obtained in practical, every-day work, depends as much upon the skill of the fireman and the construction of the furnace, as upon the inherent value of the fuel used.

Mr. GARSED. With us who live in Philadelphia, the value of coal does not receive so much time and attention as it does in Massachusetts, the cost being much less. But a few years ago we took up a patent issued by Mr. Jasper for burning coal-dust. We fitted up our furnaces by closing the grate-bars, applying a large fan, and commenced burning the pure dust, which we bought at about twenty-five cents per ton, after all the coal was taken out, up to "buckwheat" size, and for a long time, probably a year, we burned it successfully. It reduced our expenses more than one-half for fuel; but the price of coal-dust, like that of all other articles when they become useful, very soon advanced, and not only that, but screening-dust also advanced, within four years, to a point where it was more economical to burn coal. I ought to explain that, in wetting the dust, Mr. Jasper had the idea that it was necessary to divide the water up into spray, just as the atmosphere of the rooms in our cotton-mills is now moistened. We forced the water through gas-burners. The

result was very satisfactory, except that the burners would fill up with some mucous substance in the water. The idea was that, there being no water in anthracite coal, it was necessary to supply it to this coal-dust. It seems that in practice that was the fact. I think our consumption of fuel was reduced down to about a cost of eight dollars a day, from nearly thirty dollars a day; and, reckoning the expense of firemen and the expense of taking the additional dust out, it brought our expenses down to about one-half, so long as the coal-dust remained at the low figures. In going through with the experiments, we found that a large volume of air was needed, rather than a heavy pressure. The pressure would blow the dust up into pyramids, as it were, and deaden a portion of the fire while the other was alive. It was a difficult matter to keep the fire even, with this light material, with a heavy blast, from that reason. We have now adopted "buckwheat" coal, I believe, where the draft is sufficient without fans. Probably with the present price of "buckwheat" coal, it is the most economical fuel used in our part of the country. In New England you must add the freights for the low-grade coal, when you might for the same freights as well have had high-grade coal. That is an element which must go into the computation. Where we have forty thousand tons of dust a year, within a mile and a half of our works, it is not a matter of so much consequence. It seems that, in burning the fine coal, it is necessary to have a large amount of air and no pressure; otherwise you will disturb the surface of the fire, and let the air go through in greater quantities at certain places than necessary. Where there is a proper combustion of the fuel, probably the most economical coal for a New England mill to burn to-day would be chestnut coal.

Touching the subject of bituminous coal, we see that there is a large amount now consumed in New England. Our experiments show that there is about twelve and a half per cent more steam in burning good bituminous coal than for good anthracite. I think the cost to-day would be about six dollars per ton.

Mr. CHARLES NOURSE. I would like to ask the gentleman about the bituminous coal which is used under boilers. Would it require more help?

Mr. GARSED. I think it would. But that would not amount

to much. We clean the flues by blowing them out with steam. We only blow out once a week; and, as to firing, we only use one man. When the strike took place in Pennsylvania, we bought a thousand tons of bituminous coal, and fired in the same way as with anthracite. The grate-bars should be set down thirty-six inches from the boiler to burn bituminous coal, where, with fine anthracite coal, you ought to come within fourteen inches, probably in order to give you good combustion. And also, as you are aware, to burn bituminous coal you are compelled to have a larger volume of air over the top of your fire, or back of the bridge-wall. In order properly to consume your coal, or rather to prevent smoke, let air pass over the top of the incandescent coal to inflame the gases. The furnace requires to be altered, in that respect, between burning bituminous and anthracite coal.

Mr. CHARLES NOURSE. Is there any gentleman present who has been using the Jarvis Setting?

The CHAIRMAN. Will some gentleman present give us his views on that matter? I should be surprised if, after all Mr. Upton's talking, there was no one who had used it.

If there is no further discussion on this subject, the next topic suggested by the Board of Goverment is: "The comparative merits of iron and steel shafting, with results to be given by members as to the use of each."

Professor Ordway has just come into the room, after having delivered his lecture in another part of the building. The Board of Government had some talk with him about remarks upon the subject of coal.

Mr. GARSED. I had hoped that we would have a very free discussion on the subject of cards. Let us hear from some gentlemen who have had the Foss & Pevey cards.

Mr. JOHNSTON. I referred to that card in the few remarks I made, in hopes some gentleman would take up the cudgel and give us his experience. There are hundreds of gentlemen in New England who are committed to those cards, and I would like to hear the facts and the practical results touching their use.

Mr. BARROWS. I would say, in reference to the experiments we have tried, that our work is entirely on sea-island cotton.

Our work would of course be entirely different from the work of most of the gentlemen present, the staple varying from an inch and three-quarters to two inches in length. We have put in the Foss & Pevey cards, with some alterations for our particular work, and we find that our average is very much less than the average given on the table here for the quantity of cotton to each card; and it would be very much less than the scale given by Mr. Sawyer, on what we call our fine work. At numbers from 140 to 200 the average is about nine pounds to the card, single carding, and from Nos. 50 to 140 about thirteen pounds to the card. Where with the single top-flat card we were doing thirteen pounds, with the Foss & Pevey card we would do about nineteen pounds, if I recollect rightly, with about four per cent less waste, and yarn four ounces stronger than yarn made on the top-flat card. Our experiments have been in process some six or eight months. I am not prepared to say very much about it; and, as our work differs so much from the work of the rest of you, I should like to have you see it. I give these points as what we have done, and what can be done by the card. Nearly double in the quantity per card, four per cent less waste, and two ounces, which would be six per cent in strength, gained on numbers from 80 to 180, and, as I say, four per cent saving in waste on our cotton, which is valued at thirty-five cents. That is a very material saving. In the new mill we are putting up now, with one hundred and fifty thousand spindles, we are putting up single carding, with Foss & Pevey cards.

The CHAIRMAN. I would like to have you give the Association your views in regard to the principle upon which this improved condition of things rests, — whether it is upon top-flats, or upon the improved arrangement of the card. What is it that makes the difference, according to your observation?

Mr. BARROWS. My observation of the practical working of it seems to show that the greatest quantity of dirt is taken out by the under-flats. Our carding is very light. We card as little as possible. The under-flats take out the greatest quantity of dirt, so we can get the cotton through without working it to death. The staple being so long, if it was worked as much as in the old cards was necessary, we would make more waste, and reduce the strength. After the cotton is all combed, the Foss & Pevey cards would make less waste

than the top-flats. That is in addition, I think. There is between one and two per cent saving in the combing, on the Foss & Pevey card.

The CHAIRMAN. In your view, from observation, is the quality of the carding, *as* carding, better, or is it simply that it is cleaner? Is the sliver from a card of that kind in better condition to spin, except as being cleaner?

Mr. BARROWS. I think it is in better condition to spin, otherwise the work would not be as uniform and strong.

The CHAIRMAN. In your view, does the increase of top-flats increase the carding quality of a card, or simply the cleaning quality?

Mr. BARROWS. The cleaning quality, I should say, more than the other. It practically increases both. It increases the cleaning quality, from the fact that we suffer less waste, and it improves the quality of the carding from the fact that we can spin numbers of great strength.

The CHAIRMAN. If you have less waste from the use of the Foss & Pevey card, with the same weight of lap, is it fair to infer that more dirt has been taken out, or less?

Mr. BARROWS. It is fair to infer that there is more dirt taken out.

The CHAIRMAN. If you have less waste from the Foss & Pevey card, from the same weight of lap?

Mr. BARROWS. That is not exactly the way to put it. In one case what we would call "dirt" would be sand, grit, shell. That is what I meant by "dirt."

The CHAIRMAN. If it were demonstrated that the dirt you take out in one case was all dirt, and in the other, part cotton, that would be an argument?

Mr. BARROWS. No: we can separate the dirt so that in getting the dirt out we don't make as much other waste. It does not take as much cotton with it; we get the cotton cleaner, and we have less waste to sell, — four per cent less waste to sell. We get the dirt out better, and by doing that we get finer spinning, and in consequence of it, it shows less waste in the comb. If the cotton had been tangled up and broken, the comb would take out more waste, and you would naturally say that it would destroy some of the fibres, so that when the comb took hold of it to pick out all the short staple, it would take out more. This leaves it in such condition that the comb would take out less,

which leaves better carding, at the same time that it cleans the cotton better.

The CHAIRMAN. The increase of top-flats increases the quality of the carding?

Mr. BARROWS. It does, in our work. Because it does it in our work, it does not prove that it would in ordinary work. It does not follow as a matter of course that it would do it with upland cotton.

Mr. LUDLAM, of Lowell. I am very glad to bring to Mr. Barrows' support the example of a mill using Foss & Pevey cards on ordinary work. I put in the first section of Foss & Pevey cards that were ever put in. It is all I have got; but it is because I have not had occasion to add to my carding facilities since they were put in. I corroborate Mr. Barrows' experience, and that of Mr. Johnston of Cohoes, in respect to the value of single carding for comparatively low numbers. If I were going to equip a mill to-morrow, up to No. 33 I should put in single carding. The reason of Mr. Barrows' saving in his comb is perfectly clear, and is due to certain features in the Foss & Pevey cards. The fact that he gets less waste in the comb is due to the fact that the fibre is not chopped up, as it is with double carding. The Foss & Pevey card is like all new things, — somebody has got to shake the tree. My cards were made from first patterns, — made by the Lowell shop. They afterwards improved them again and again. The Foss & Pevey cards of to-day are much better than the cards I have, but my cards answer my purpose very well. I am carding fifty-two pounds a day. The yarn is stronger than that which comes from the double carding, which is as good as most of our neighbors have.

With respect to the damage from the weathering of coal, of which the gentleman from Woonsocket was speaking, I would say that Dr. Percy is an English writer of the first rank. But his remarks apply more to bituminous coals than to anthracite, which is entirely unknown there. Not so dense in its texture, it contains much more of the volatile elements, and the damage is much greater than with anthracite.

Mr. JOHNSTON. Did you use double carding, Mr. Barrows?

Mr. BARROWS. No, sir: only single carding in both places.

Mr. JOHNSTON. What was the speed of your doffers in both?

Mr. BARROWS. It was the same as with the Foss & Pevey.

Mr. JOHNSTON. That accounts for having less waste. In the first place, he kept his cotton in the card, and worked on it to a greater or less extent, single. In this case he speeds up to an additional speed, to make up for the difference in the card. You can card too much, and break the staple, and make more waste.

Mr. GARSED. I would ask some gentleman who has had experience with the Foss & Pevey card, whether more benefit comes from the "licker-in" than with the Foss & Pevey card.

Mr. LUDLAM. With respect to that, I should like to say that my cards were the first built, and my cards have not that peculiarity. This is one of the improvements that would not have been adopted otherwise. There must be some gentleman here who has the Foss & Pevey cards of modern construction, that will answer the question.

The CHAIRMAN. The only object I had in making the remarks I did about the card, was to draw out the views of members on the subject. I hope we shall have a continuance of the discussion.

Mr. STILES. I don't know as I can explain the many advantages — for there are many — of having "lickers-in" rather than these. It seems to me it is better to have the "lickers-in," because I think a large proportion of the carding, — perhaps I ought not to say a large proportion, — but there is a proportion of the carding done by the "licker-in," when it takes the cotton from the feed, rolls it, breaks the cotton up, prepares it, and puts it in a state to be carded by the cylinder. I will simply give you some facts with regard to the mill with which I am connected. I went there a year ago, to Newburyport, to the Victoria Mills, and we had one hundred and twelve cards, using the double-carding process. It was decided to throw those all out, and we bought forty-eight Foss & Pevey cards, built at the Lowell Machine Shop. At that time our average production was eleven thousand two hundred pounds of cloth. After we decided to put in those cards, I thought it best to test the yarn thoroughly, — No. 20 warp, and see how strong yarn we were making with the double carding. We averaged it for a number of days. We tried twelve single

threads a day, for two or three weeks. They averaged to break at seventeen ounces and a fraction. After we had the Foss & Pevey cards going, — we were using precisely the same cotton, — I tested that yarn the same number of times, under the same conditions, and they broke at twenty-one ounces and a fraction. We have increased our production very largely, and I attribute a great deal of it to the better carding we get. It was so much better, that, when I sent the cloth in to Boston, the selling agents and the treasurer laid one side all the samples they had, and asked me to send the samples of the cloth that was made after we got the other carding a-going. We are making an average of sixteen thousand pounds of cloth, the carding all done on these forty-eight cards; and I have in the mill one grinder, at one dollar and ten cents, and a man who works half of the time on a grinder, at same price; one stripper, and two railway-boys. The stripper I pay ninety cents, and the boys get fifty cents each. That is all the help we have on the carding, and we do sixteen thousand pounds of cloth per week on an average.

Professor ORDWAY. I was sorry not to be in at the time the paper on the subject of "the Combustion of Fuel" was read; for I have no doubt it was one of great interest, one of those which we greatly need. It is very important for us to have practical experiments. The books we have are mostly European books, and the English books we have are those which relate, not to such fuel as we have in New England, mostly, that is, good anthracite coal; for I think there is very little anthracite coal in England that is similar or very nearly similar to our own Pennsylvania coal. What their authors say relates mostly to bituminous coal, which is of an entirely different character. Our anthracite coal has been exposed by nature to such hard usage that it cannot be hurt much more. It cannot be hurt much by weathering, whereas bituminous coal is in a continual state of decomposition. In the mine it is continually giving out gas. After it is taken out of the mine, we are not quite so sensitive as to mind the gas given out. But we know by experiments made of late years, that if we take a portion of bituminous coal, heat it to a moderate temperature, — to a temperature a little above that of boiling water, — for several hours, it continually loses. If it loses at that temperature in a few hours, it must lose a good deal by exposure to such summers as

we have in this part of the country, for weeks and months. I believe nothing of the sort has been known to occur with regard to anthracite coal. It contains, to be sure, a good deal of a sort of pyrites; but this is not in such condition that oxidizing it throws the coal apart, as with bituminous coal. We generally find, if we take egg coal, pea coal, nut coal, lump coal, or furnace coal, and expose them for any time to the weather, there is very little change, either in the way of breaking up or in the appearance itself of the surface of the coal. We should see something in the surface, if there were any great amount of change. We have the very best fuel in the world for making steam. Anthracite coal is stronger than any other. It will give more heat per pound than any other fuel except petroleum; and that it is impossible to use, for it is dangerous and costly. It will give more heat than bituminous coal. There is some disadvantage, and that is that it does contain a good deal of ash. The accounts we have in many of the books of the analyses of coals are hardly fair. We see it stated that a coal from a certain locality contains five per cent of ash. We get a few tons and try it, and find, on keeping careful account of the clinkers and ash that pass through the grate, that there will be from ten to twelve per cent. I see in the results given that there were fifteen from pea coal, and twelve from the other. This, I believe, is a fair amount. The fact is, that, in breaking up coal, they let go into smaller coal a great deal of slaty matter. The coarser the coal is, the purer it is. That will agree with the experience of almost every one who has examined this matter. I had occasion, a few years ago, to use a large quantity of lump coal. It was in large lumps, and professed to be extraordinarily pure, because being in lumps they could not get much slate in it. Such was the case. We found it more advantageous to take this lump coal (it was taken from the layers of pure coal, and put into the market) than to use that which had been broken up. It was some trouble to break it; but where a man has nothing to do but take care of steam-boilers, and has several to help him, he can do it as well as not. There is an advantage in getting this large lump coal for large establishments, on that account. But for smaller operations it is better to have the coal sized, for small fires. Then we can keep up a uniform fire. We shall not have the air passing through in such a way as to burn it in one spot, and not burn it at all in another spot.

It passes through very uniformly. When I was a boy, anthracite was just coming into use. We were obliged to buy it in the lump, and break it up with a hammer. It was hard to keep up a fire in those days. We don't have that trouble nowadays, for the coal is sized. We have what is called "range" coal, of a very good size to burn, for ordinary grates and stoves. If we want to keep a large fire, we want it in larger lumps, so that the ashes will not fill up the spaces between, nor prevent the access of the air. The great secret of burning coal to advantage, is to have it so that the air will pass pretty freely through. It is found by experiments, that have been made with some care, that we generally use, in burning coal of almost any sort, twice as much air as is absolutely necessary. To support the combustion of coal, it is necessary to use the oxygen of the air, and to bring it into contact with the coal. If we break up coal very small, we can bring the air in closer contact: or, theoretically, it would be better to have the coal in the form of pea coal; the spaces are smaller, the oxygen is brought in closer contact, and it is used up. If we admit more air than is necessary, this air carries off the heat, for the air must go off a good deal hotter than the steam in the boiler, if it is steam we are making. We introduce cold air, and heat it up to four or five hundred degrees. It will go off generally, in most manufactories, at about 500° Fahrenheit. Of course, if we introduce double the amount, or treble the amount, of air that is necessary, as is sometimes done, it carries off a great deal of heat. Theoretically, if we could bring the air into complete contact with the burning coal, we should not use so much coal. The heat produced would be more intense and available. But, practically, I am not at all astonished to see the results that have been obtained. The pea coal produces an ash that fills up the spaces between. The spaces are very small: when the ash is formed, it fills them up, and you cannot separate it so easily; consequently the air will force itself through in some spots, and not in others. If you could keep the coal clean all the time, it would be another thing. If you have coarser coal, there is much less trouble with its filling up the spaces so that the air cannot get through equally to every part of the fire. Egg coal is a good deal better on that account, for keeping a clean fire. We have particles of slate and particles of ash, and they do not fill up completely the

spaces between. The air can get through, and we can have a pretty complete combustion. The ash in the red-ash coal will fuse to a clinker. That is objectionable, because the clinker fills up the grate, and prevents the access of air. If we have a very intense fire, we are very apt to get clinker. I think every one who has looked at this matter will find that with pea coal you have a pretty intense combustion right through the grate, just where the ash is most abundant, and is in a good position to be fused by this intense heat produced. And it will be found by careful examination that the amount of clinker produced by pea coal will be much greater than that produced by egg coal, or even by what we commonly call "steam coal," or furnace coal, coal of a larger size. The heat is very intense in just that spot, perhaps one or two inches above the grate.

I will mention here the experiments made by Deville, in France. He wanted to get up an intense heat that would melt platinum. He found he could do it with a blast furnace, with coke broken up to the size of peas. He found that where the blast was introduced into a furnace of this sort, the intensest heat was just about two inches high. If we take pea coal, and have the air introduced by its own force, or blown into the ash-pit, the heat is intense where we should prefer not to have it intense. We should prefer to have it intense near the top of the coal. If you use small coal, and have the fire of any depth, it is absolutely necessary to blow into the ash-pit, and you have the condition that Deville had when blowing air into his furnace. The combustion is very perfect in the small space where it is taking place, and the heat is intense, and fuses the ashes together, and the grate becomes covered with a sheet of clinker. But no further combustion can take place until that clinker is broken up. It would be interesting if we could have experiments made with still larger sizes. But it would be necessary in all cases to state the depth of the coal on the grate, of course. If we use the pea coal, and want to keep a good fire and have combustion complete, we cannot have a high stratum; for if we fill the fireplace pretty full, the small spaces will produce too much friction. If we use egg coal, we can have it deeper. If we use coal still larger, we can have it deeper still. But, if we take the very largest coal there is, one difficulty is that the largest coal is apt, when thrown into the

fire, to snap all to pieces, and we get coal of all sizes. Really here is an objection again; because, if it snaps to pieces in different sized lumps, the small lumps would fill up these spaces where the air ought to go through. If we take the lump coal and break it up rudely and throw it into the fire, we cannot expect to have the fire very deep, and have it burn to good advantage. You can probably have the deepest fire with coal of the egg size; that having been broken quite uniformly, it is not so liable to splinter when thrown into the fire. This splintering is occasioned by the gas retained by the anthracite coal. Anthracite coal has been found by late experiments to retain a large quantity of gas, — a quantity which is equal to twenty times its own bulk, — by the peculiar force of attraction. Of course this is retained by the peculiar substance of the coal, and when coal is thrown into the fire the gas tends to escape, and the coal is blown to pieces. This will happen to a large extent with small coal as well as with large; but the smaller the coal is broken, the less in proportion there is of this splintering, and the less, therefore, there is of inequality produced in the size of the particles which are in the fire. If you have large lumps and small lumps in between them, you can fill up the spaces as completely as if the fire had been burning all the time, and it was filled with ashes. It is a great disadvantage to keep stirring the fire, for we shall let through the grate more or less of the small coal. That is a necessity, and you can't help it; and this small coal that passes through into the ash-pit is lost, — four or five per cent of all the coal used, in some cases. It amounts to a good deal more than the smoke which we get from bituminous coal. That looks large, but amounts to very little really. The anthracite coal, as we all know, is particularly advantageous for tubular boilers, because it does not make the smoke and soot which is liable to fill up the tubes. We can have tubes of two and a half to three inches diameter, and not have to clean them out very often. But on the other hand, the anthracite does make more ash than the bituminous. This ash is very light, and is carried forward into the tubes, so as to fill them up; and they must gradually be filled up. That is not so bad as the flakes of soot which accumulate in the tubes. The bituminous coal wants to be burned with pretty large flues; but undoubtedly the bituminous coal can be burned under boilers, provided we have three-inch tubes: the Cumberland coal is very good in that respect; it can never yield so

much refuse as anthracite, and the price per ton is about the same. If we take bituminous coal, or Province coal, we shall find, as a general thing, a pretty large amount of ash, and unfortunately that ash is very fusible. I have been astonished, in burning Pictou coal on a large scale, to see how soon the grate would be covered with a complete sheet of clinker. This is always the case where you want a pretty hot fire. You must run in your bars, break it up, and open the door and hook it out, and there is a great deal of heat lost in that process. A rule of prime importance in all cases where we have a fire is to keep the fire-door open just as little as possible: you find that firemen do not think very much often of this point. I have seen one keep his fire-door open, turn around and talk, and spend five minutes in that way. He ought to throw in the coal, and get all through with it in half a minute; then there would be very little trouble: the trouble is, that, if the grate-door is open, say, sixteen by twelve inches, the cold air is rushing in with prodigious velocity, carrying off the heat, mixing a great quantity of cold air with the hot air, and carrying it off up chimney. There is a great deal to be saved, I think, by getting men who understand the business of firing; we don't always exercise care enough about that. You will find all the difference in the world about that. Some men are naturally pretty slow in their motions, and it will take them two or three times as long to fire up, as it will other men. If a grate is to be cleaned out, it takes them two or three times as long as it does other men. I have seen this particularly in the smelting of lead, where I have had occasion to use a reverberatory furnace. I had two men, one working at night, and the other in the daytime; one man would always get out from the same charges and the same amount of firing one hundred and fifty pounds more of lead than the other. I paid those men the same price, but I got sick of it after a while. It is not worth while to pay one man a dollar and a half per day for wasting one hundred and fifty pounds of lead worth five cents per pound. People do not always think of this. I believe you will find it more advantageous to pay a man five or six dollars per day, than two: a better class of men, who will be intelligent enough to see to all these little points. It makes a difference whether you have your fire-door open five minutes or two; and it makes a great deal of difference whether you hook the coal unnecessarily, and let it through the grate. A great deal of this latter difficulty of letting coal

through the grate, has been attempted to be obviated by patent grates. We have all sorts of patent grates, some of them shaking grates, very good; others, grates with very small spaces, which, therefore, can be coated over with clinkers pretty easily, and soon are stopped up. The manufacturers will always warrant that they will save you thirty per cent at least of the fuel used before; I cannot say that this is exactly so. There is an advantage in the shaking grate, because you can clear out the ashes without opening the fire-door. Of course, if you can keep the grate clean, and break up the clinkers without opening the fire-door, it is a great deal better. I had occasion to look into this matter of grates a few years ago. A man came along with a particular grate-bar, supposed to save thirty per cent of the coal. He had certificates from manufacturers to show that it would do it, and was quite sure that that was the case. I told him I would take one set, and we would try those. The old grates were very heavy, — one hundred and twenty pounds per piece, — and they had never been bent or got out of shape at all; they worked very well. We put in this set. When they came, I told our man to observe very carefully the amount of ashes he got through, and weigh it all, and the amount of ashes from the other fires. He did not find any difference at all in the amount of coal consumed, or in the amount of ashes; but in six months the new grate was used up pretty nearly, — warped all out of shape. I took it out, and put in the old grate-bars, taken out of that same fire, and they lasted four or five years without any change. One of the advantages claimed for the new grate was, that it would never warp or get out of shape: it was said to be a great deal better than any of the old grates. I met this same man who introduced this grate a year afterwards in Providence, and asked him about his grate-bar. He said, "I have taken up another one now. That bar was not quite as good as the one I am introducing now. This new one is a great improvement on the old." I told him I didn't believe there was a great deal of improvement about the matter any way. I told him my experience with the grate-bar I had introduced in place of my old one. There is more in the fireman than there is in the grate-bar, and more in man than there is in the coal.

As to the question of the weathering of coal, of course it is important to keep coal covered on one account. It is disadvantageous to have coal out of doors in rainy weather or snowy

weather: when a man goes to gather up the coal, he shovels up half a wheelbarrow full of snow with it, and that is thrown into the fire. It is advantageous to have all the dryness you can. The water you throw into the fire does not increase the heat, but diminishes it. The blaze that follows the throwing in of the water is produced by the decomposition of the water, and then its subsequent re-composition. If you get an intense fire of anthracite coal, and throw in a quantity of water upon it, it will blaze with a blue blaze. The fire being very intense, there is a sudden and rapid decomposition of the water into carbonic oxide and hydrogen, and, as that gas rises, it ignites, and we get a sheet of flame. But it takes up a great deal of heat to change that water into gas. We have just as much heat taken out as we get back again when it is burned in the form of gas. This principle of the conservation of heat, or the conservation of force, is pretty well understood nowadays. We don't believe now that it is advantageous to burn green wood. It is advantageous to get rid of all the water we can in fuel.

It is advantageous to get rid of the pyrites in coal, — that which occurs in Nova Scotia coal, in lumps as big as your fist, and blackened over. When you throw a lump of that kind into the fire, it will generally melt. It stops the grate, and eats into the grate. I have had grate-bars eaten half through by pyrites that kept trickling down, red hot, eating into the iron. When it is in such a state it is very disadvantageous. What we have in our anthracite coal mostly is very small indeed, in thin plates. We cannot get rid of it by picking simply; we cannot get rid of it by the process of washing, because it is an exceedingly dense coal, and these plates are in the interior of the lumps. We may wash or weather it as much as we please, and we don't get rid of that pyrites. In the bituminous coal it is somewhat different. It may be partially broken up. The bituminous coal is more apt to be in layers that will come apart and show the pyrites between these layers. As it splits up we set free these particles. It is not so with anthracite coal, which is not apt to split up in layers, as the bituminous coal does. We may gain undoubtedly by washing the coal, and this holds more particularly in the use of coal for metallurgical purposes. They find, for instance, at Johnstown, Penn., where they have a coal that contains a great deal of sulphur, that it is very advantageous to wash it. It is all broken up of the size of a hickory-nut, and the large lumps of pyrites all roll out of

the sieve in which it is broken up; the coal going through. The other part is washed on jiggers, at some expense. Still it pays, because they get a coke, finally, which is free from sulphur, or nearly so, and in such a case they are working with a coking coal, so when they coke it, it runs together, and they get coke good enough for all practical purposes. The trouble with washing coal is just that, if they break it up and it will not coke, they get coal too fine to burn without blowing a blast through it. We cannot get a draught through dust-coal of any sort. When it is dust-coal we must use a pretty forcible blast to blow through it. That makes a great many particles to drop through the grate. It is disadvantageous to break up bituminous coal. It would be very disadvantageous to break up the anthracite coal any finer than egg coal, if we can help it. Some of it gets broken up, and is convenient for those who have occasion to make small fires. With pea coal we can get a fire with three or four inches of depth, that would be pretty intense. With egg coal we should have to get it four or five inches deep. The pyrites that is with the anthracite is not very liable to change by mere oxidation. There is a great deal of pyrites in the bituminous coal which oxidizes with the greatest ease, and it heaves the coal all apart in a few weeks, or in a few months, at any rate. I have a few specimens of a very good coal that I got in Nova Scotia a year or two ago, that have been kept in a drawer. I went to look at it some time ago, and found the lumps broken to pieces, and effloresced on the outside with sulphate of iron. The slight amount of moisture in the air had got to this, and oxidized it, and changed the pyrites to crystals, and broken the coal all to pieces. We never see that with anthracite. It is hardly worth while to wash or weather anthracite. It is best to have it of uniform size, if we can get it so, and of moderate size, and have it in as great a degree of purity as we can get it. As for the time it is kept, whether two months or two years, it makes very little difference if we keep it under cover. It does not need to be kept under cover, of course, as much, by any means, as wood or bituminous coal. And there is this fact that I have already alluded to: if we leave it out of doors in winter, and a man goes out to get a wheelbarrow load of it, he is sure to get the coal very wet, and mixed up with lumps of ice and snow; and in the furnace you are evaporating a great deal of water, and using your heat to melt a great deal of ice instead of burning coal. It is very desirable

that the experiments that have been made should be carried further, and different sizes of coal tried week after week and month after month, and a careful record made of the result; and at the same time it would be well to note whether the coal that is thrown in snaps to pieces very much. This, I think, is rather an important item. If it does not snap, — and some coal is of a character that it does not snap much, — of course it is a great deal better than that which snaps very freely. There is a great deal of difference in different sorts of coal. We find, for instance, our Western cannel coal will snap when it is thrown into the fire. The English cannel coal does not. I have often thought that it might really be advantageous sometimes if we could only season or anneal this coal before it was burned. We could get a better fire if we would take egg coal and heat it nearly to redness, and let it cool slowly, so as to season it; then we could keep it of pretty uniform size until it was well burned out. We could have a distribution of air more free and uniform all over the surface of the grate.

Mr. CHARLES NOURSE. Can you give us any experience as to the distributing of heat by the aid of steam?

Professor ORDWAY. In that connection I will mention an illustration of what might be done in that respect. I found, some time ago, they were burning bricks over in Somerville with coal instead of wood. In order to burn coal to advantage, it was necessary to spread the heat. The heat was too near the fire. They found it necessary, or advisable, in burning the coal to bake bricks, to blow in a jet of steam over the fire, and carry forward the hot air into the interior of the kiln, so that the heat might be spread. The steam did not add any thing to the heat, it simply distributed the heat; it diminished it. It was necessary to use a pressure of one hundred pounds to the inch. It was rather an expensive way of spreading the heat. I believe in all cases it will be found that steam adds nothing to the positive amount of heat produced; it simply does something towards the distribution.

Mr. STILES. I was speaking just now about our No. 20 yarn. It occurred to me that gentlemen would think those were the only numbers we made. Our numbers run from 20 to 38, averaging about 30.

Recess until two o'clock P.M.

AFTERNOON SESSION.

THE Association re-assembled at two and a half o'clock, and was called to order by the Chairman.

Mr. GARSED. A minute or two upon the subject of coal. Professor Ordway seemed to lead us in the direction that all small coal was likely to clinker on the grate-bars, or the ashes would collect on the grate-bars, and thereby prevent the draught. In Pennsylvania we know that one kind of coal will not clinker, and another kind of coal will not choke up by the ashes. Again, if I understood him right, he said that cracking and splintering and flying around was evidence that the coal was not of good quality. It is a fact that the best anthracite coal in Pennsylvania, the "Buck Mountain," is so liable to crack and fly around, and burn the carpets, that we decline to use it for domestic heating; but it has more steam in it than any other. We never stir the fires with anthracite coal, we only stir them up where we use bituminous coal. We burn the finest kind of fuel, and take care to get the right kind for the purpose. You can, in Pennsylvania, find coal of such a character that it will clinker, and still let the draught through. It is honey-combed; but it does let the draught through. With an indiscriminate kind of coal, of course you have trouble.

I hope somebody will speak of the Foss and Pevey cards. I came all the way from Philadelphia to hear them described. Some few years ago I came to New England, and was told by manufacturers that a "licker-in" on a finisher card, if not on a breaker card, was an injury. I went home and made experiments which seemed to verify the assertion. We see before us a finisher card, with two "lickers-in." I would like some one to tell me if the "licker-in" is an injury to a finisher card. When the sliver had been previously prepared on a breaker card, I would like to have him explain why were two "lickers-in" put on the finisher card. I trust some gentleman familiar with the matter will tell us why they put a "licker-in" on the finisher card. Our friends in Fall River have the cards. The Chicopee

Company have the cards. We all think we know something about the subject. Let us hear what gentlemen have to say. The claim has always been made that a "licker-in" on a card clouds the work; that the tendency is to send the cotton across the card, sometimes gathering a very much thicker sliver than at others. I doubt not it is so. It is a fact that can be easily established. We are of course anxious to have the best card. If the Foss and Pevey card will do more work for the floor space, and for the labor, it is a very important matter that we should adopt it. It is a still more important matter that we should adopt it exactly right. We should not go on and take up the subject as it looks there on the sketch, and have to alter it after a while, and go back. It is a simple point for somebody that has the experience, to tell us why they have put it on the flat card there. I hold that card is a finisher card. It is claimed that, if you put the work through once, it is done as well as with the double carding. I think I have seen it done as well. I think very few men could see the difference between double carding and single carding with the Foss and Pevey card; but there was no "licker-in" on it.

Mr. SAWYER. I understand that Foss and Pevey make them both ways, with the "licker-in" and without it. They have made them with the feed-rolls close to the cylinder. The Willimantic Company, in their first experiment with the Foss and Pevey card, tried it as it is shown, and did not meet with good success with their long-staple cotton. They afterwards abandoned those rolls, and put the feed-rolls close to the cylinder; and they were so well pleased that they adopted them, as we heard this morning.

The CHAIRMAN. Mr. Garsed makes inquiry as to the "licker-in." The time was when all New England abandoned the "licker-in" on cards, as being a damage. His inquiry is, Why is the "licker-in" introduced on the Foss and Pevey card? Can any gentleman give us any information or any views upon that subject, as to its original history or its present use?

Mr. GARSED. Some gentleman in the room said that he used "lickers-in" on his breakers, but not on the finisher. It is a simple point. Here is a "licker-in" put on a finisher. That which I now indicate to you on the platform is a finisher card.

The CHAIRMAN. What was the reason for their introducing the "licker-in" on that card?

Mr. GARSED. The idea, from my stand-point, was to prepare the cotton, and tear it up, for the cylinder; i.e., to correct the liability of the cotton lap to become unequal; portions being thicker than others in consequence of the tendency of cotton to adhere together in a mass, greater than is desired. The "licker-in" had the tendency, or we supposed it had, to prepare that hard lump of cotton better for the cylinder wire, than it would be to bring the feed-rolls direct to the cylinder.

The CHAIRMAN. It was a settled thing that the wire on the cylinder was different from the wire on the "licker-in"?

Mr. GARSED. Yes, sir. It has been diamond wire until within a few years, — not universally. Now if the fact is that it is necessary to have the "licker-in" applied to finisher cards, — whether the idea was to distribute the cotton, or tear open these hard knots, I would not like to say. It is true that there are more "lickers-in" in New England on breaker cards than there are on finisher cards; and there are men that would probably defend the "licker-in" on breaker cards, who would not do so on the finisher card. I would like to have gentlemen draw the line that I make. *This* [pointing] is a finisher card with a "licker-in."

Mr. LEIGH. I know a large mill in England that applied "lickers-in" to finishers, for sea-island cotton, with great advantage. They have a very large number of cards, — probably run two hundred thousand spindles. They put on "lickers-in," and covered them with Garnet's wire. It is a metallic wire, very like the flat wire now being put on "lickers-in," set in leather. At the time, it was discussed a good deal whether the "licker-in" was suitable for finisher cards for sea-island cotton. I remember very well these "lickers-in" being tried, and I know they are in use to this day, and made a very great improvement in the working of these cards. The wire on the cylinder lasted longer, and the carding was perceptibly improved. The universal practice now in England — and, in fact, I may say everywhere, except, perhaps, this country — is to build the cards with "lickers-in." I think the "licker-in" is a very good intermediate between the picker and the clothing on the card-cylinder. It breaks up the lumps of cotton. It evens them out, and gives the cylinder a better chance of taking it by degrees. When you put a cylinder up to a pair of feed-rolls, and feed it with raw cotton, it is not the order in which it ought

to come. The "licker-in" is a very good intermediate for that purpose. At all events, all the cards made in England have "lickers-in," whether breakers or finishers.

Mr. JOHNSTON. Mr. Garsed asked the question, why, in the modern-built card of 1880, we go back to what was called a discarded idea, the idea of "lickers-in" on breaker or finisher cards? I will throw out a suggestion on that matter. If they come to you, or any manufacturer, and present the claims of their card: what is it? Not that it is a card with flats, so much as that it is a card that will do twenty-five to fifty per cent more work. How do they get this additional work? They get it from a single card, not by the top-flats, which are only to receive dirt, but by the additional wire-surface whereby you can card an additional amount of cotton better than you can with ordinary wire. You cannot do that with the lap as it ordinarily comes from the lapper. It is uneven, some parts of the cotton very much opened, and others solid and compact; and to make good work we know we have to have wire middling fine. But if the cotton comes from the lapper in this confused condition, right directly to the main cylinder, it injures the main cylinder. If you *crowd* it through, your card will throttle and fail, and the work fail with it. You put this "licker-in" on, which receives this cotton in this shape, and, the wire being made strong, it prepares the cotton; and the cotton, instead of being worked upon by the "licker-in," and injured by that, comes to the cylinder in a thin sheet, is acted upon, and is more prepared to throw off its dirt. If Foss & Pevey will take their cards, running at speed, and take that lap and run it right up to the cylinder, you will find there will be more dirt in the work. The cotton will not be so relieved of its dirt as to deliver it into those flats as freely as it does with the "licker-in." For increased work I say a "licker-in" is a necessity, if you are going to get any extra quantity of work from a card.

Mr. GARSED. Do I understand you to say that the increased work is at the expense of clothing?

Mr. JOHNSTON. No, sir, not at all. If you put down that additional carding-surface, and deliver your cotton in so much better condition, even with an additional quantity, to your cylinder, by putting on your "licker-in" you could certainly improve the quality of your carding over what it would be if

the "licker-in" had not been there. The "licker-in" is a necessity where you increase the quantity to be carded. It is a necessity, to carry out the idea, in the Foss & Pevey card, of the quality and quantity of work, taken in connection with the other features of the system.

The CHAIRMAN. You remember that in a good many of the finisher lappers they put in cylinders covered with teeth. Would it not be better to leave that on the lapper, and have that in proper condition there?

Mr. JOHNSTON. The gentleman would find we increase our fly-waste and our little tufts of broken cotton by putting that fine cotton on the cylinder. It is very harsh, and it is more apt to break the cotton than it is after it is placed to the "licker-in."

Mr. GARSED. If the "licker-in" gives the quality to the card and its value, why should we not apply the "licker-in" immediately to all our finisher cards? The "licker-in" was discarded here because it spoiled the work of the finisher card. How is it that you put that work back again upon the finisher card?

Mr. JOHNSTON. I am afraid that calling that a finisher card will not make it so. When they asked the President to issue a certain proclamation, he said that it would have no effective force. They said, "You can call it a proclamation with authority." His reply was, "Calling it so don't make it so." So with the old conundrum, "How many legs does a calf have, if you call his tail a leg?" The solution is found to be that calling a tail a leg don't make it so. Calling a breaker card a finisher card does not make it so, certainly. All we have to do is just to take and look at the two cards, — look at the cotton as it comes on to the cylinder from the lapper or from your finisher card. In one case your fibre is all straightened out, and the cotton carded beautifully. Look at the fibres of the breaker lap, and it is all broken off irregularly. The condition of the cotton from the lapper or breaker cards is very different.

Mr. GARSED. Then I misunderstand this card entirely. All the arguments to-day seem to be that the card produces a larger amount of work, and I am free to confess that I have seen some that did as well as with double carding. If it does, then of course it is a finisher card, as well as a breaker card, — a very desirable thing for us to get. I cannot get my friend

Johnston away from the idea that this is a finisher card. If you are going to put another card on afterwards, it is a breaker card.

A MEMBER. I move that the name be changed, and that they be called "breaker-finisher cards." Then we cover the ground.

Mr. GARSED. Except that *that* is a finisher card with a "licker-in."

Mr. JOHNSTON. You cannot get away from it in that way. The "licker-in" is the breaker, and the card without the "licker-in" is the finisher.

The CHAIRMAN. I am in pursuit of knowledge on this subject, as well as the Association. I hope you will pardon me for occupying a few minutes of your time, with a view to getting information. The established plan, when the "licker-in" is introduced, is that it has coarser teeth. We want a certain fineness of the teeth, to card cotton properly. This discussion brings out to my mind this single point, which I would like to submit for you to answer: Were top cards introduced originally for any other purpose than cleaning the cotton? [Draws illustration on the blackboard.] The sliver from the lapper comes in *here*. If the card runs *this* way, of course it is pulled down over *there*. We all know in sampling cotton, if we want to straighten it out and see how the fibre looks, we pull it out in *that* way. The action of the card is precisely the same. The rolls hold it, and straighten it by the velocity of these fine teeth across it. The question comes to me whether those coarse teeth will card it as well, — at the place where all the carding is done, — will the coarse teeth card the cotton as well as the fine teeth would if they come in contact with it at that place? Let us take it for granted that all the carding on the cotton is done *here*, — the straightening of the fibre with the card. Suppose we introduce a top-flat here. It does not touch the teeth anywhere; but there is a certain amount of cotton accumulated on the surface of this card, that we will say, for the purpose of discussion, has been carded all that it will ever be. From *this* point to that first top-flat, there is a smooth, silky surface of cotton lying on the surface of the teeth. In that cotton there are bits of dirt and seed that have not been got out of the laps by any operation whatever. Some portion has been got out *here*, and thrown into the dust-box below; but they still

remain to a certain extent. These top cards are left a little further over here, the design of which is, that they shall take the larger lots of dirt, &c. When that top card catches a little bit of leaf or seed that lies on a nice smooth sliver of cotton, does it not irritate it? It pulls it out, and the surface is irritated. You go on and do that, and when you have got this cotton over *here*, I say it is not as smooth; it does not lie as nice and slender when the doffer takes it off as it did down here. The question is: Do top cards card, or only clean? I say the carding on the card is all done *here*. If you want No. 32 wire to do your carding, you must introduce it *here*. If you introduce a "licker-in" *here* for the purpose of cleaning cotton, that is one thing. I question whether you can ever card it as well afterwards, by taking it off of that "licker-in."

I introduce this as my view, with the object of keeping up the discussion. I really am in want of information as to whether top cards card. But assume that they card: everything else being equal, the rolls of the same size, the sliver of the same size, whether the cards are any better for the multiplication of top cards, is information I would like to get.

Mr. GARSED. I suppose, Mr. President, that the "licker-in" was introduced before pickers were as well and as scientifically made as they are to-day, for the purpose of throwing down from the feed-roll, at the commencement of the operation, a large amount of seed and trash that is in the cotton, that should not go upon the cylinder, and as another way to distribute the cotton on the cylinder as evenly as possible. Now if we throw overboard the notion that the "licker-in" did not throw down the trash, that it was a mistake, why, then, it is of no advantage to-day, other than to save the wire of the cylinder, provided you make the feed-rollers small enough in diameter so that the length of the cotton fibre shall not exceed the distance of the wire of the cylinder to the centre of the feed-rollers. That is just what happens with the licker-in, — that the cotton is received by it in clouds, or in larger bunches than it should be, distributed on the cylinder in that same condition, because the "licker-in" combs it only partially. Take out the top feed-roller and put a concave plate there, as is practised in some cards of large production, the cylinder coming exactly at the edge of that plate. Then you come to the combing process, to get rid of the danger of the cotton

not being held back until it is combed. I am trying to give some reason why "lickers-in" were introduced, supposing pickers were not as perfect as they are to-day. It is easy to see that if the cotton should come from that feed-roll a shorter length than its diameter, the cylinder could not take hold of it and comb it out. You take a piece right out by the cylinder, and wait until it comes to the first flat before it combs it at all. Half of the diameter of feed-rollers is greater than the whole length of upland cotton. Hence a difficulty comes in there, which was remedied by a feed-roll being made to fit into a concave plate. That will account in some degree for the fact of the "licker-in" throwing down the seed and the large leaf. The effect of gravity in this case was in favor of the seed and trash falling. In the other case it has nothing to do with it, because the cylinder is taking it from the feed-roll; and, going in the other direction, of course before the cylinder takes it, there will be still a large amount of dirt there. The "licker-in," introduced on that card, is for the purpose of doing the work before it reaches the flat.

Mr. LEIGH. I was going to remark that I don't believe that card will produce any thing near as large a quantity without a "licker-in" as it will with it. I don't think any card will. I remember some twenty odd years ago my father put flats below the cylinders: the lap was fed in the ordinary way; the cylinder and doffer turned the other way (you have probably seen it illustrated in his book); we had a great deal of wire on it. In fact, this is a miniature of that card, with this exception: that flats were below, and rollers above. We started it up with five hundred pounds per week, and soon saw that the cotton was over-carded. We speeded it up, and when we got to seven hundred and fifty pounds, the cotton was very much better carded than it was at five hundred, showing that it was over-done. And I think if that card was reduced down to the same quantity as is put through the small card, it would be over-done: that is to say, there is too much wire to pass through. It is a great fault to have too little carding; but there is another fault, and that is carding too much. There is a happy medium, and I think it rests — with that card as with the one my father tried his experiments with — in just getting the proper quantity of cotton to go through in a certain time. But I am certain, from what I have seen in connection

with the matter, that the card will not do any thing like the quantity of work without the "licker-in" as it will with it. In the first place the "licker-in" takes a good deal of dirt out. It straightens the fibres, and feeds the cylinder regularly. It does not take it off in blotches, as it does with a pair of feed-rollers put up to the cylinders. And if the "licker-in" is covered with proper wire, that will not carry cotton, — wire that runs clear; diamond-pointed, flat-toothed wire, such that you cannot see the cotton when you take the cover off, — and the cotton is delivered to the cylinder before it makes a revolution, a "licker-in" is a good thing. But if a "licker-in" carries cotton, it is a very bad thing, because it delivers it irregularly. The cylinder begins to strip it only when it gets full, and takes it off at intervals like a blanket; it goes on again, and keeps accumulating cotton, and so you get an irregular delivery to your cylinder. But where you get a "licker-in" with metallic wire, or wire that keeps clear, delivering cotton from the feed-rollers regularly, the "licker-in" not only takes a great deal of dirt out, but delivers it to the cylinder in better shape, with the fibres straightened out. It saves cylinder-wire, and will not require so much grinding. I know from what I have seen that the card will card more cotton with a "licker-in" than it will without it.

As there is no one else to occupy the floor at this moment, I will give an account of some experiments that I tried with a card similar to what we have been discussing. It was in relation to the quantity put through. We had a card with twenty flats, and we put a certain quantity through. We reduced the number of flats from twenty to fifteen, by taking the wire off. We then reduced them down to four, — from twenty to four, — and found that we got almost as good a result, — I forget exactly the quantity that was put through. It was not quite as clean, but it was better carded and stronger. The card seemed to card as well with the same quantity of cotton passing through, as it did with twenty, showing that it is easy to over-card.

Mr. PEVEY was then called for, and spoke as follows: —

I supposed the discussion properly belonged to you manufacturers. If any gentleman wants any cards, I am always ready to put in my oar. There was one thing brought out this forenoon in the discussion: I understood Mr. Ludlam to say the

card was put in with two "lickers-in." It was put in with one "licker-in" clothed with diamond points. This "licker-in" struck up the same as when applied to common top-flat cards.

We did not get good results until we put in the second "licker-in," which was clothed with round wire, and ground the same as the cylinder. The "licker-in" next to feed-rolls struck a down blow; the second, with round wire, struck an upward blow, and transferred the cotton from the first "licker-in" to the cylinder, which struck a down blow. With this arrangement we got satisfactory results, the cotton being very much better cleaned.

Again, in working it on the sea-island, of which Mr. Barrows spoke this morning, I don't think the gentleman understood that his cards were without the "licker-in." They attempted to work the long-staple cotton on the card as it is now, but the long-staple cotton would wind right around the first "licker-in" so closely that the second was unable to clear it. They thought it was a failure: but Mr. Scott, the superintendent, removed both lickers-in, and placed the feed-rolls right up to the cylinder; and since then they have had good success.

The CHAIRMAN. Has the same experiment been tried on short cotton?

Mr. PEVEY. Yes, sir; the result is good, so far as I know. There are twenty-four cards being run by the Woonsocket Yarn Company without "lickers-in." We claim with this card to work the cotton above the dirt and sand, in the first process of carding; while with other cards, that work the cotton over the cylinder first, the reverse is the case. We have the advantage of the aid of gravitation during the first process of carding by the under-flats, as some dirt drops out between them; and when they are stripped, more comes out with the strippings, and falls to the floor.

Mr. LOURIE. You leave the flats open far enough so that when they are working there are spaces for them to work?

Mr. PEVEY. Yes, sir. These under-flats were left more open for that purpose. I am not a manufacturer; but I have to talk with a great many carders, and all agree that they want to keep the cotton from lodging in the card; that is, after it leaves the feed-rolls it wants to be kept on the wire of the cylinder, and carded by the under and top flats until it is removed by the doffer. This prevents cloudy work at the doffer.

The CHAIRMAN. That would apply on any card, I suppose; but on the other style of card it was thrown off by centrifugal force on to the floor.

Mr. PEVEY. In passing the cotton under the card first, the under-flats clean and remove more leaf, nits, and dirt, than we do with the top-flats, and more than is done with a top-flat card. We think we show a cleaner cotton, and a better laid fibre. The gentlemen may be interested to know the number of cards of this kind that have been ordered for the last year. For the year ending Oct. 1, 1880, one thousand seven hundred and forty-nine cards have been ordered of this kind, with and without "lickers-in."

Mr. GARSED. Have there been "lickers-in" added to the plain cards?

Mr. PEVEY. Not to my knowledge: they are built with or without, to suit purchasers.

Mr. SAWYER. It seems to me that, whenever the teeth set in opposition to each other, as they do between the cylinder and the tops, and also between the cylinder and the doffer, there must be carding done. The carding is not only done between the cylinder and the tops, but between the cylinder and the doffer. The speed of the doffer is very slow compared with the speed of the cylinder. Whenever the fibres are drawn through between teeth pointing in opposite directions, there must be carding done; whenever they point in the same direction, there is no carding done. When the cylinder takes the cotton from the feed-rolls, it is picked off and carded, and there is a tendency to straighten the fibres; when it takes it from a "licker-in," there is very little carding, because the teeth are set in the same direction, and it is simply taken off and unloaded. I suppose that, so far as the carding action is concerned, it would not be as well to take the work from the feed-rolls to the cylinder by a "licker-in," as it would to take it *directly* from the feed-rolls to the cylinder. But there may be other important advantages in favor of using the "licker-in." If it is as well, then of course we ought to introduce it into our finisher cards.

Mr. UPTON. I have been here three years, and never had the courage to address this assembly before. A good many questions have come up in regard to cheap fuel. As I have

made that a study for the last three years, in connection with the Jarvis Furnace, I would like to give the Association the results. If everybody, they ask, goes to using screenings of anthracite coal, will it not soon cost as much as lump sizes? This has led me to thoroughly investigate what the means of supply were at the mines. I find, on the authority of Professor P. W. Shaefer, Pottsville, Penn., that sixty-five per cent of all the coal mined is wasted at the mines. This has been going on since 1820, and he estimates that there are eight hundred million (800,000,000) tons of screenings now lying there in waste heaps. It is now being transported to the sea-board for the first time. The amount of screenings made at the ports of delivery, like Port Richmond, Elizabethport, and Port Johnson, are in addition to the waste at the mines. Port Richmond alone makes forty thousand tons of screenings every year, and three-fourths of this is transported to the New England States. We have applied our furnace to over one thousand (1,000) boilers, chiefly in New England, and ninety-five (95) per cent of them have been successful. We cannot overcome the disadvantages of poor chimneys or poorer firemen. When the owners or agents of mills wanted economy, we have always been successful. We have set more tubular boilers than any other kind; and consider the plain tubular boiler, made of steel plates, the best and most economical steam generator now before the public. We have also had good success with the upright Corliss type of boilers, as our setting relieves them from gas, thus preventing the numerous gas explosions; also enables us to use screenings without a blower. We find the same result with the Harrison and Babcock & Wilcox boiler. The poorest type of boiler in use is the plain cylinder. It is so long that the middle plates are weakened by the constant expansion and contractions. We find, where we have applied our setting to this boiler, that the temperature of the gases enter the flue from 700° Fahrenheit to 800° Fahrenheit, which is a great loss, and would be saved in a return tubular boiler. The great waste in combustion of fuel is the unconsumed gases. Every one using a common house-furnace can imagine how much larger it is under steam-boilers. The advantage of the Jarvis Furnace over the old style is, that, by the admission of hot air (oxygen) over the top of the fire, this gas is made into a second flame. The intense heat thus generated allows us to use all kinds of

waste fuel without a blower. This includes screenings, slack, bituminous coal, wet logwood, wet sawdust, and wet peat. In regard to the last, I would say that we have a number of mills using this class of fuel; and, when the bog is handy, it is the cheapest fuel in the world. The time is coming when a peat-bog will be as valuable as a coal-mine; and I would further add, that, by our process, the wet peat requires no preparation or drying, but is mixed in a wet, loose state, with a small amount of soft coal. One of the most successful improvements of this age is the Siemens Furnace for melting steel, brass, glass, and other materials. This is, in reality, a gas furnace. Coal is slowly burned to gas and smoke, and, at the entrance of the furnace, it is joined with highly heated air (oxygen). This combination makes the highest heat known in a furnace. The economy in fuel over the old process of making crucible steel is seventy-five per cent. In a different manner and on a smaller scale the Jarvis Furnace is applied to steam-boilers. I do not agree with Professor Ordway on several points. First, we find by actual experiment that we get much better results by wetting fuel to the extent of forty per cent. In his address this morning he says, —

"When wet fuel is used, the moisture must be vaporized, and so heat is taken up and wasted. The vapor either passes off directly and carries away so much heat, or it re-acts on the ignited coal to produce hydrogen and carbonic oxide. Such a re-action uses up a very large amount of heat; but this is recovered when the gas burns, and is reconverted into steam. The conversion and reconversion just balance each other. But in any case the heat required for vaporization is totally lost."

While this is the result with boilers set the old way, we claim that, by discharging hot air (oxygen) over the top of the fires, we supply the chemical element needed to produce a *hydro-oxygen* or blow-pipe flame. To produce this result, the air joining the gases must be heated to at least 500° Fahrenheit, the point of combustion. For over fifty years experiments have been made to obtain these results by the introduction of cold air; but it has proved to be a failure in every case, as the air admitted must be hot enough to join with the gases, without decreasing the temperature of the flame. Second, Professor Ordway speaks of burning screenings with a blower as the only way this fuel can be used; our success without a blower fully answers this point:

and let me say here that the use of blowers is gradually going out of existence. They have proved to be a nuisance in many ways, being dirty and dangerous, throwing cinders and sparks all over a mill, to say nothing about the injury they are to boilers by directing the flame always on one spot. It is safe to say they reduce the life of the boiler one-half. Third, Professor Ordway sees no difference in grate-bars. In practice we find a great difference. To get perfect combustion requires a large supply of air through the fire, and it must be thoroughly distributed. The old-style grate-bar has only about thirty-three (33) per cent air space, when, to get the best results, we find fifty (50) per cent is necessary. If grate-bars are made with the bearers setting back from each end, they can never burn off if the ends are clear.

Our average results on lump and bituminous coal have been from ten to twelve per cent. I find, from actual tests, that bituminous coal is more economical than anthracite. We do not claim to get so large an evaporation from cheap fuel as can be obtained from good coal, but the difference in the cost of the two fuels allows us to get a large economy even with using more fuel in weight. The only true test of economy in fuel is to find out what coal gives the largest amount of heat for the smallest possible cost; in other words, what fuel will evaporate the largest number of pounds of water into steam for a dollar's worth of fuel. I place no reliance on fancy tests in evaporation: unless the temperature of the steam is thoroughly tested, I consider them of little account. We find one serious trouble in New England, and that is, the chimneys, as a rule, are too small. Some mills have been started with one boiler and chimney built suitable for it; but, as business improved, or the water gave out, more boilers were added, until three or four boilers were working on a chimney just large enough for one. I know of one mill in Lawrence that has twelve boilers discharging into a chimney that is thirty-six inches square, or thirteen hundred (1,300) square inches. The combined area of the tubes of these twelve boilers is about five thousand (5,000) inches. The area of a chimney should be as large as the area of the tubes of the boilers discharging into it; and, if one-quarter larger, it would be better. In furnishing plans of chimneys, we make the core gradually expand as it rises, so that in a chimney one hundred (100) feet high, the core should be six inches larger at

the top than at the base; with a chimney two hundred (200) feet high, the expansion should be twelve inches. The Merrimac Company, Lowell, will soon commence building the largest chimney in the United States. It will be two hundred and seventy-five (275) feet high, and require one million three hundred thousand (1,300,000) bricks. The question of fuel and steam is getting to be important in the New England States. With the increase of machinery and low water in our rivers, it is safe to say that it will double in the next ten years. Steam is also destined to become the means of heating our houses and stores. We have applied our system to five different companies in this country to convey steam through the streets. The longest distance it is carried under ground is four miles: all trouble of condensation is thoroughly overcome, and the pressure at the extreme end of the line is only seven pounds lower than at the boiler-house.

Mr. JOHNSTON. In speaking of patent grates, I have had a little personal experience with one, that I think may be useful, and serve to show that to have too much of any thing is oftentimes a great injury. A concern, running a large number of boilers, say, that if they lose ten or fifteen per cent, or half a dozen boilers, they don't know the difference: whereas if they gain in the amount of fuel consumed, they are sure to notice it. That is the sort of illustration I am about to give. There is a patent grate-bar made, not a thousand miles from this city, which was "cracked up" very highly at one time. The theory was very good; but the practice I didn't think quite as well of: so I fought against it. After a while the man came to me with a recommendation from a party with whom I was acquainted, stating that there was a saving of thirty-five per cent of the fuel. I knew that the person who gave the recommendation would not have done it unless it had been true; so I had the man change one of my boilers, and this is the result: we saved over forty per cent of fuel. If I had simply weighed my coal, and made the saving that way, I should have said that was the greatest secret ever discovered, — enabling us to get along with sixty tons where we had used one hundred tons; but that is not where the saving comes in. We burn coal *to make steam.* In taking the water supply to the boiler, I found we were getting a very poor result from that boiler, — a result which showed that the boiler was not giving more than half its

capacity. After running a while, and being dissatisfied with that, because I found we did not get steam enough, I took those grate-bars out, after trying the experiment of fuel and water, and put back the common plain bar, a very good one. Then I was using the whole amount of the coal, or forty per cent more than we were using under the patent bar; but I was getting over sixty per cent more evaporation of water. Now there is your patent grate. A person may have more steam-capacity than he requires; a dozen boilers, doing how much work he does not know. He measures his coal, and says the saving is so much; not taking account of the water evaporated. In regard to the furnace introduced this afternoon; if I had had a surplus of steam, I would have condemned the furnace, because I used under each boiler twenty per cent more fuel than I did before I put in that furnace. I tried some experiments; but, when I measured the water, I found I evaporated fifteen per cent more water per pound of fuel, than I did with my old furnace.

Mr. LOVERING. Did you say you evaporated fifteen per cent more water per pound of coal?

Mr. JOHNSTON. That was the statement. I said we used twenty-five per cent more fuel than under the old boilers, but evaporated thirty per cent more water. The lowest was twelve, the highest fifteen; so that where I was using five boilers, I stopped one boiler, and did the work with four.

Mr. GARSED. Was this with a Jarvis setting?

Mr. JOHNSTON. Yes, sir.

Professor ORDWAY. In regard to setting, in using the same kind of coal that was used previously, how much saving can be made by putting in Jarvis setting?

Mr. JOHNSTON. I use good fuel. I don't use dirt. I don't burn peat, and I don't soak coal. I don't send for trash down to Pennsylvania, to get this result of which I have spoken. I tried trash at one time, and I am willing now that other people shall burn it if they want to. The result I gave you was from good, clean coal.

Mr. WARING. Our boilers are the Corliss upright, from which they claim the best results. A little over a year ago, we put in the Jarvis setting; and for a time the weekly reports of amount of coal, as returned by our fireman, showed a saving. In less than three months we found we were using as much as

before we made the change. They claimed that we should save from eight to ten per cent over old setting on same coal, and a saving of twenty to twenty-five by using pea and dust coal. We burn No. 2 Lehigh chestnut, the same as we have burned for four years. We have not found any saving by making the change, I am sorry to say.

Mr. GARSED. I think it is fitting that we should tender the thanks of the Association to Messrs. Sawyer and Parker for their exhaustive papers upon the subjects presented by them, also to Professors Whitaker and Ordway for their instructive discourses upon coal.

The CHAIRMAN. Will some gentleman introduce a resolution to that effect?

Mr. GARSED. There is one piece of business that will get beyond our reach if we do not attend to it now, and that is, with regard to the article in the by-laws, brought to bear for the first time this morning, in reference to the admission of new members to the Association. The matter had better be taken up, and decided upon its merits before we proceed any further; for it must always be an unpleasant thing to propose a name under circumstances like those which occurred this morning. I see that there is an ambiguity in the by-laws. It says, "any gentleman of good moral character, who now is, or *hereafter may be*," the owner or manager of a cotton-factory, &c. It is necessary, of course, to have persons associated with us who are connected with the business of the manufacture of machinery, and also those who erect mills and tell us how to make them more substantial. At the same time we must have some rule, and live up to it. But this rule had better be modified in some way. It does not mean any thing.

The CHAIRMAN. It occurred to me, when the gentleman was proposing the resolution of thanks, whether it would not be well to embody in that resolution a request for the drawings that were exhibited. I mentioned at the time they were introduced that they were only designed for use at this meeting; but it seems to me, that, for the proper elucidation of the subject in our published proceedings, we should have those drawings. I should desire that the gentleman who is to offer the resolution should introduce in it that subject in some way.

Mr. GARSED. Do I understand that you wish the Association to buy those drawings?

Mr. BARKER. It seems to me that, after a gentleman has been so thoroughly advertised here as Mr. Pevey has, and after the whole batch of drawings has been turned over, to come to the Pevey card, and all the business of the meeting has resolved itself into a discussion of that, the proposition to pay money for the illustrations is rather an audacious one.

Mr. GARSED. I did not understand that the gentleman who brought the drawings here had any interest in the Foss & Pevey cards. I thought it was only a matter for illustration.

Mr. BARKER. We heard the lecture that was given, and it seemed that the lecturer was a shopmate of the inventor of these cards, and was on very intimate relations with Mr. Pevey. It really struck me at the time, when the paper was being read, that Mr. Pevey could afford to give the gentleman eight or ten cards for the splendid and magnificent advertisement that his machine has got here to-day. I apprehend it would cost thousands of dollars to advertise a card so thoroughly and completely, and so entirely on one side, as that card has been advertised here to-day.

Mr. GARSED. I would come a thousand miles to hear a discussion on cards, — the Pevey card or any card. It is not all one-sided. I have derived a good deal of instruction from the illustrations that have been given here. The only regret I have is, that the gentlemen did not wade right in and say what they could against it. This is the place, of all others, to introduce new and good machines, if it did not take us into too deep water; if the subject was not one to take up valuable time. But there is nothing more important in my estimation to-day than the thorough analysis of carding, with illustrations before us, just like these. If I could have got the illustration in no other way, I would have been glad to have paid a large sum for the privilege of being instructed by it here.

Mr. BARKER. I am very sorry I was not here to hear the discussion. The principal part of what has been said, that I have heard, is, that there has been seventeen hundred of these Pevey cards sold; that it is a single card, with "workers and strippers," or two "lickers in." I probably have lost a great deal in not hearing the discussion. All the discussion that I have heard in regard to that card, amounts, in my mind, to very little. I have had a little experience in carding. I had charge of a card-room twenty-one years. I ought to know something

about it; but, in the light of modern science and modern cards, I am really all at sea, and have concluded that I don't know any thing about it.

Professor WHITAKER. The diagrams were made to illustrate "Some Successive Steps in the Invention and Improvements of Flat Cards." I wished to make one *fact* evident. It was this: Many practical men have acted as if they had a theory, that *to increase the number of flats is to improve the performance of the card.* I am accustomed to use diagrams in lectures before classes, and knew that I could make this fact apparent more rapidly and distinctly if I exhibited the diagrams at this meeting. I felt authorized to do this under the general invitation which was extended to all members by the Board of Government. I preferred, however, not to use my privilege except by vote of the Association; and I prefer *now* that they should not appear in the report of this meeting, unless it is the wish of the Association that they should form a part of the permanent record. I thank the Association for their vote requesting their exhibition at this meeting. I cannot permit the Association to *pay* for the diagrams; but it can publish them, or not, as it sees fit.

Mr. GARSED. Our course heretofore has been to have these subjects up before the Board of Government, as to whether they should be illustrated, or otherwise, in the publications of the Association.

Mr. BARKER. I move that the plans be submitted to the Board of Government. I believe that we have a Board of Government that is able in every sense to do justice in regard to the matter of advertisements.

Professor WHITAKER. The gentleman has inferred from my paper that I was a shopmate of Mr. Foss, and on very intimate terms with Mr. Pevey. I did say in my paper that Mr. Foss was my shopmate. I think that I have seen him but twice since I left the Lowell Machine Shop. I did not even mention the name of Mr. Pevey to-day, and I have never been on intimate terms with him. *The name "Foss & Pevey card" did not pass my lips; neither did it appear on the diagrams which I exhibited.*

Mr. BARKER. I didn't mean to cast any reflection on Professor Whitaker. I come from a State that needs instruction on this matter, and craves all the light it can get. I came up

here to Boston to hear something in regard to the Pevey card. I would give more for the information to be derived from one good practical carder who has had experience for a series of years, than for all the theories between the Atlantic and Pacific Oceans. We are getting too full of theories. We have had "grate" on the brain, and "card" on the brain, and not a practical man has come up here to tell us a word about a card. It is somebody who has got an idea from drawings. Now what I know about manufacturing I didn't learn in that way. I had to commence at the beginning, and work through the various stages until I understood it. As I said when I was up before, with the modern science of carding and modern cards, I am really about fifty years behind the times, according to their theories.

The CHAIRMAN. I would like to say to Mr. Barker, that, if my memory serves me rightly, he was here through the discussion this forenoon, and that previous to his coming in after dinner, there was very little said, except some inquiries from Mr. Garsed as to why "lickers-in" were introduced. I made efforts to get gentlemen to discuss this matter, and I regret that Mr. Barker did not "pitch in" earlier. I know the spirit of the Board of Government in relation to the matter: here is a thing that claims to be, *par excellence*, THE *card*. I could not see why. I was in hopes we should be able to bring out the reason here to-day. I confess to a paucity of information upon the subject yet. Mr. Barker has had his fair chance in the matter, and has been urged several times to express his opinion in regard to this card.

Mr. BARKER. I never have worked with one. I came up here to hear about it.

Professor WHITAKER. Mr. Barker cannot have understood me this morning, or he would not seem to intimate that I had advanced certain theories in my paper. *I stated some facts, but I advanced no theories.* The recent remarks of the gentleman cannot, then, be applied to my paper.

The CHAIRMAN. The Secretary will read the names of any other parties proposed for election to membership.

Mr. PEVEY. I propose the name of Mr. D. C. Converse, of Cliftonville, N.C., who is the principal owner and manager of a cotton-mill there.

A MEMBER. We ought to either change the by-laws, or else cut this thing off. To-day is the first time I have heard of a man being black-balled in this Association, since I have been a member of it. I think it is wrong to vote against the men proposed now, unless we act consistently in all cases of the same nature.

The CHAIRMAN. This matter has been before the Board of Government. It was really a matter which we disliked to touch. A manifest injustice has been done in this regard. We have here a gentleman who never was a member of the Association, and never paid a cent towards its support, but who has taken as active a part on the floor as any other man. There are others who have taken an active part in the discussions, and have been supposed to be members in good and regular standing, that are not members, and have never been voted on. We noticed this unfortunate phraseology. The question was, what we should do as a Board of Government. It was simply left in this way: that, when the time came for introducing new members, we should read the article, and let the Association do as they pleased. When it came time to elect members, I read this article with a view to call your attention to it. It would be in harmony with the feelings of the Board of Government that a motion should be made to change this article, and that notice be given at this time that such change will be made at the next annual meeting.

Mr. BARKER. The gentleman says that the applicant is an owner in a cotton-mill. Well, sir, if we should admit all the owners in cotton-mills to our Association, we should want half of Boston Common to meet upon. I think that in the corporation with which I am connected we have something like five hundred different owners. I know of a corporation, not a thousand miles from where I hail from, that I have heard had twelve hundred and fifty stockholders. Now if we are going to stretch this thing so as to admit everybody that happens to own a share in a corporation, we had better be seeking some larger quarters pretty quick, in order to accommodate them. Therefore I hope that this motion for the admission of this man will not prevail.

Mr. GARSED. One word in explanation of the matter. This morning my friend seemed to feel it keenly because objection was made to a name which he proposed. Had the gentle-

man who introduced the name stated that the candidate was an architect of cotton-mills, the probabilities are that the man would have been elected. I took exception to it because I could not understand why a man who was spoken of simply as an architect should be granted admission here, or as a civil engineer. I knew there was nothing in our rules that allowed the admission of civil engineers.

Mr. BARKER. It was stated afterwards that the gentleman was a builder of cotton-mills.

The CHAIRMAN. It was during the discussion, but not until we began to vote upon the subject. It did not change the nature of the discussion.

Mr. GARSED. I suppose the gentleman just nominated is as much entitled to election as any man in the Association.

Mr. SHAW. I would now be glad to vote for both him and the one nominated this morning. I think the majority would like to have them in membership with us. I think that they both should be treated alike.

The CHAIRMAN. Suppose there should be a motion of this kind: that the application of this gentleman be passed over to the Board of Government, in view of changes that may be made in the by-laws.

Mr. BARKER. We must have some place where we can draw the line in regard to this thing. If we do not, it is an easy matter for the Association to degenerate into an association of some other branch of industry.

Mr. JOHNSTON. There seems to be a little feeling about this matter which ought not to exist. I don't think the gentleman was black-balled this morning. The point was simply made, that, according to the by-laws, he should not be admitted. I don't think this case is a parallel one to that of the gentleman from North Carolina. He is not only the owner of a cotton-mill, but, as it stated here, the manager of one. Managers are what you want here, whether called superintendents or treasurers. The case this morning requires an amendment to the by-laws before the gentleman can enter. If we are to act as business men, we want to carry out what is prescribed in our by-laws. We ought not to have any feeling about what was done this morning. It was not intended for black-balling.

Mr. PENNELL. I will move, Mr. Chairman, that the Board of Government be requested to submit, at the next meeting

of the Association, an amendment to the by-laws, covering this point.

The SECRETARY. I will call attention to the article of the by-laws which it is proposed to amend.

Mr. PENNELL. Do I understand that the Board of Government are to make the recommendation, and then we are to take such course as we elect?

The CHAIRMAN. The by-laws require that notice shall be given in writing at one meeting, and the matter acted upon at the next.

Mr. PENNELL. Then I move that a committee of three be appointed by the Chair to recommend an amendment, with the understanding that I am not to be on the committee.

The SECRETARY. A committee would have hardly time to give the matter sufficient consideration at this meeting; and a notice in writing that an amendment will be submitted at the next meeting, will accomplish Mr. Pennell's purpose.

Mr. PENNELL. The point which I am aiming at, is simply to take such action this afternoon as will insure a free discussion and the final adoption of an amendment at the next regular meeting, which will *plainly* and *fully* define the qualifications for membership to this Association.

Mr. SAWYER. I am glad that this matter has been brought to the attention of the Association. I am quite willing that it should rest where it is. With regard to the gentleman nominated this morning, he is deeply interested in mill-building, and in the questions which we discuss here. I think it best that his nomination be referred to the Board of Government. But I move that the other gentleman be admitted.

Mr. PEVEY. He is the president and general manager of a mill.

The question being on the admission of Mr. Converse to membership, a vote was taken, and he was admitted.

The resolution of thanks to Messrs. Sawyer and Parker, and Professors Ordway and Whitaker, having been reduced to writing by the mover, was adopted as follows: —

Resolved, That the thanks of the Association be tendered to Messrs. Sawyer and Parker for their valuable and exhaustive papers upon the subjects assigned to them by the Board of Government, and to Professors Ordway and Whitaker for their interesting and instructive addresses.

The CHAIRMAN. Mr. Pennell submits in writing the following notice: —

Notice is hereby given that at the next meeting an amendment to Article VIII. of the By-Laws, in regard to the qualifications of membership, will be presented for the consideration of the Association.

The SECRETARY. A simple notice is all that is required.

The CHAIRMAN. The matter of the drawings was left to the Board of Government.

There being no further business, the Association adjourned.

APPENDIX.

BOSTON, Nov. 20, 1880.

JOHN KILBURN, Esq., *President.*

DEAR SIR, — I hastened my return from the South, in order to be present at the last meeting of the Association; but I was delayed one day, and so missed it.

I desired to submit the substance of the enclosed statement, which, since then, happens to have assumed the form of a communication to "The Planters' Journal."

As it is pertinent to the discussion of picking and carding, I should be glad to have it included in the report of the meeting with this note of explanation.

Yours truly,

EDWARD ATKINSON.

[COPY.]

BOSTON, Nov. 19, 1880.

F. C. MOREHEAD, Esq., *President Mississippi-Valley Cotton-Planters' Association.*

DEAR SIR, — My recent conversation with you upon the subject of the proposed cotton exhibition and the objects thereof, induces me to present certain points to the members of the Planters' Association which do not appear to be well understood.

It seems to be assumed, that, because cotton is sold at a certain price per pound, for the gross weight of the bale, therefore the bagging, iron hoops, and sand, are sold at the full price of cotton. There could not be a greater delusion.

When the cotton reaches Europe, the allowance made for tare is a little more than enough to compensate for the bags and ropes; the little more constituting a sort of guaranty or insurance against the risk.

In respect to the cotton used in the United States, a careful account is kept in every factory of the amount of waste from bagging, hoops, sand, and other waste, and great care is taken not to

repeat orders in places where there appears to be a liability to an excess of waste from these causes. Clean cotton, of fair staple, brings a better price than dirty cotton of extra staple.

If a careful computation be made extending over a score of years, it will be found that the average price paid in Liverpool for cotton at net weight (tare having been allowed for bags and hoops) is as much higher than the price in New York for cotton at gross weight, as will compensate for the tare, the freight, the insurance, and other charges.

If cotton were sold in New Orleans with an allowance for tare equal to the weight of the bags and hoops, the price would be advanced in just the same proportion, or a little more.

In point of fact, what is paid for is the fibre that is worked into cloth, and nothing else; if the packing of the fibre is bad, a less price is paid for the contents of the bale than would be paid for the same contents properly packed, because all bad packages imply a risk of loss to the consumer, and the consumer is, in the long run, perfectly sure to get such an abatement on the price he would otherwise pay as will cover the waste, and a little more as a guaranty.

Every consumer will pay a higher net price for an article so packed as to make him sure of both the net quantity and quality of the stock that he buys, than he will for an article so packed as to leave these points uncertain.

The present barbarous method of packing American cotton costs the cotton-grower, in my judgment, from one to five per cent on the whole crop.

One per cent is the minimum for the guaranty against an excess of bags and hoops, and five per cent would not be excessive as a guaranty on sandy and dusty cotton.

That is to say, if all cotton, middling and above, were packed in clean sacks, held by light wires. and kept free from dust, rain, and wind (tare being allowed for the bags and wires used), the producer would receive an additional price equal to the tare, and also one to three per cent more money for each bale, than he now receives; and if all cotton below middling (thus graded because of leaf, dust, and sand) were properly treated in the gin-house, the cotton-grower would net two to five per cent for each bale more than he now gets.

The above estimates are based upon continuing the present mode of ginning, the present construction of gins and presses, and the present method of baling (except a substitution of wire for hoop iron). That is to say, the value of the cotton crop to the producers can be increased two to five per cent without any fundamental changes, but merely by improved methods in the use of apparatus, and such greater care in these present methods as reasonable economy would call for.

But there is a very much greater saving within the reach of the Southern cotton-grower; one that would add not *less than ten per cent to the value of the crop*, but *not* at the cost of the consumer. If that part of the manufacture, which must be done where the cotton is grown, were done in a skilful and suitable manner, the consumers would save in the labor of converting cotton into cloth all that the producers gained in the price of the cotton.

To state this point in the most incisive way, I will venture the assertion that the greater part of the American cotton crop is deteriorated, and its value reduced *ten per cent*, between the time when it is picked in the field, and the time when it is turned out from the compress to be shipped abroad or to the North.

The smaller portion, ginned in large establishments, carefully managed under good discipline, is probably as well handled and as free from deterioration as is consistent with the present mode of ginning and baling; but, as compared to the treatment which the cotton receives after it reaches the factory, the *whole crop* is *badly treated* in the South, and the larger part of the crop *very badly*.

In order that this point may be fully comprehended, it is necessary to consider the work that is done in the factory to prepare cotton for the process of spinning.

The bale of cotton reaches the mill after having been subjected to excessive compression; this compression does not apparently injure the fibre, but it makes it much more difficult to remove dirt, leaf, motes, and other trash, than if the fibre had been subjected to a suitable treatment immediately after leaving the gin, when it was in the lightest or most open condition.

In the picker-room of the cotton-factory, the bale of cotton is subjected, first, to the action of an opener to lighten it up and overcome the effect of compression.

Second, it is passed through the breaker-lapper, or picker, to remove seed, sand, and heavy dirt; this machine usually contains two, sometimes three, metal beaters, revolving at a speed of twelve to sixteen hundred turns per minute, the outer rim of each blade moving four thousand to six thousand feet per minute.

Third, it is passed through the finisher lapper, or picker, containing two, sometimes three, beaters, to complete the work of cleaning, and to make a lap suitable for the first card.

In England the method sometimes varies from this, the cotton being passed through a succession of three machines, each containing one beater.

Combined in or with these machines are numerous devices or apparatus to aid in the removal of the dirt, consisting sometimes of mechanical appliances, sometimes of long trunks, with grates or grids

[redacted], correct, and not [redacted] which the largest [redacted] of capital, it will do [redacted]

[redacted]

EDWARD ATKINSON.

motes out of the cotton that now infest it in the gin-house, and in the cotton-press and yard.

If these motes, consisting of bits of leaf, boll, and trash from the field, dust and trash from the gin-house, and dirt from the bags and the levee or yard, were kept out or taken out, there would be no material difference in the weight of the bales; this is not the stuff that adds weight: and the labor and treatment of the cotton in the picker and card-room of the factory could be reduced one-half, at the very least.

One beater or its equivalent applied to the removal of motes as the cotton is delivered from the gin before compression, would be as effective as two beaters after compression; and one carding applied to clean and well-ginned cotton carefully baled, and kept clean after baling, would be as effective as double carding applied to the average of the cotton as now delivered. By reducing the number of beaters, and reducing the carding to a simple and legitimate purpose of straightening fibre, a larger quantity of stronger yarn would be produced to each spindle, and every loom could be speeded up to a greater speed with less imperfect work.

This point cannot be enforced too urgently; the cost of working cotton in the factory is increased, and the product is decreased, by the processes that are needed to remove trash, much of which gets into the cotton after it is picked, and reduces its value in the manner described.

Another great advantage in the cleaning of the cotton immediately after it has passed the gin, and before compression, would be the removal of the almost impalpable sand or dust that infests the cotton grown on many soils, and that causes great injury to the machinery of the cotton-factory, especially to the cards.

In this connection let me again call the attention of planters to the expediency of investigating the merits of the Ralston trash-cleaner, and other machines of like kind, in which very dirty cotton is subjected to the action of beaters *before* the fibre has been removed from the seed.

The seed having greater specific gravity than the dirt, sand, or trash that is mixed with the fibre, is carried by the action of the beater away from the trash detached by its action, and the trash falls behind into the receptacles prepared to catch it. I have never seen the machine, but the theory is unquestionably right.

In my previous communications I have said that the cotton manufacture is a unit. It begins on the field, and ends in the cloth-room of the factory. The most important part of this manufacture must be carried on near the field, and is the process treated in this paper.

If the South desires to enter upon the safest, surest, and most profitable career of cotton manufacturing, in which the largest results can be obtained with the least expenditure of capital, it will do well to take up these suggestions.

Very truly yours,

EDWARD ATKINSON.

[No. 30.]

N.E. COTTON MANUFACTURERS' ASSOCIAT

PROCEEDINGS

OF THE

SIXTEENTH ANNUAL MEETI

HELD AT BOSTON APRIL 27, 1881.

PRECEDED BY

CATALOGUE OF MEMBERS.

BOSTON:
FRANKLIN PRESS: RAND, AVERY, & CO.,
117 FRANKLIN STREET.
1881.

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CATALOGUE OF MEMBERS.

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1881.

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1881.

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J. M. Pusey . . .	Delaware Mills	Wilmington, Del.

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Wm. H. Thompson	Lowell Felting Mills	Boston, Mass.
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John Webster	Newmarket Manuf. Co.	Boston, Mass.
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Francis M. Weld, jun.	China Mills	Boston, Mass.

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[illegible]	[illegible]	[illegible]

Total number Honorary Members . . . . . [illegible]

Total number Active Members . . . . . [illegible]

CALL FOR MEETING.

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION,
BOSTON, April 1, 1881.

DEAR SIR, — The stated annual meeting of the Association will be held at the Massachusetts Institute of Technology, Boylston Street, Boston, on Wednesday, April 27, 1881, at ten o'clock A.M. (with an afternoon session commencing at two o'clock), for the choice of officers for the ensuing year, and the transaction of such other business as may properly come before it.

Upon notice in writing given at the last meeting, an amendment to Article VIII. of the By-laws will be proposed by Mr. WILLIAM D. PENNELL. At present, the article is as follows: —

ART. 8. Any person of good moral character who now is, or hereafter may be, treasurer, agent, or superintendent of any cotton-mill, may become a member of this Association upon his signing the By-laws and paying an admission fee of ten dollars, and an annual assessment not exceeding ten dollars. After the first meeting of the Association, and at any regular meeting thereafter, new members may be admitted upon the nomination of any member, he obtaining a majority of votes of the members present. Any member may withdraw from the Association at any regular meeting, upon payment of all arrearages, first giving notice of his intention so to do to the Secretary; and any member may be expelled *for cause* at any regular meeting, two-thirds of the members present voting therefor.

After the conclusion of the business of the meeting, the Board of Government propose for discussion the subject of Carding, with especial reference to the use or non-use of drawing.

By invitation of the Board, the President has consented to open the discussion by a brief paper, giving his views upon the comparative merits of the two systems of single and double carding.

Other members have been specially invited to take part, and it is hoped that all will be prepared to add their quota to the common fund of information on this important process in the cotton manufacture.

The subject of Picking will also be presented, and any member who has information to give on the subject is cordially urged to impart it at the meeting.

The proposed Cotton Exposition at Atlanta, Ga., will be brought to the notice of the Association, with a view to any appropriate action relating to it.

An early and full attendance is invited.

By vote of the Board of Government,

AMBROSE EASTMAN,
Secretary.

PROCEEDINGS.

PURSUANT to the foregoing notice, the annual meeting of the New England Cotton Manufacturers' Association was held at the Massachusetts Institute of Technology on Wednesday, April 27, 1881, at ten o'clock A.M.

The President, Mr. JOHN KILBURN, occupied the chair.

The PRESIDENT. I embrace this, the first opportunity, to thank the Association for the honor conferred upon me in selecting me to preside over its councils. The Secretary will read the call for the meeting.

[The call was read.]

The PRESIDENT. The next business in order will be the reading of the records of the last meeting; but as those records are in print, if no objection is made, the reading of them will be dispensed with.

The reports of the Secretary, Treasurer, and Auditor, were then read, accepted, and ordered to be placed on file.

Upon motion, the President then appointed Messrs. E. S. DAVIS, HENRY F. WEST, and WILLIAM D. PENNELL, as a committee to nominate officers for the ensuing year.

Mr. KENT. Before the Committee on Nominations retire, Mr. President, I wish to thank the members of the Association for the honor of having been on the Board of Government for several years past, but do not wish to be considered a candidate in the future.

The PRESIDENT. While the committee is absent, it will be in order to present the names of any persons for membership.

The following-named gentlemen were then proposed, and duly elected members of the Association: —

DAVID BALLOU	Woonsocket, R.I.
GEORGE C. BUCHANAN	Louisville, Ky.
A. W. DANFORTH	Newburyport, Mass.
BUSHNELL DANFORTH	Williamstown, Mass.

HERBERT R. FARNUM	Georgiaville, R.I.
JEFFERSON HIGGINS	Slatersville, R.I.
HENRY F. LIPPITT	Woonsocket, R.I.
J. CLARK NUTTING	Hooksett, N.H.
A. M. PULSIFER	Auburn, Me.
GEORGE E. SHERMAN	Newburyport, Mass.
C. F. TARBELL	Amesbury, Mass.
EBEN WILBER	Cannelton, Ind.

The PRESIDENT. While waiting for the Nominating Committee to return, I would ask Mr. Atkinson to lay before the Association such ideas as he may think proper to present in relation to the election of delegates to be sent to the Atlanta Exposition.

Mr. ATKINSON. I am very happy to respond, sir. As to the first point, the election of delegates, in view of the magnitude of the exposition, the great development it has taken since its first suggestion, it seems to me that every member of the Association who can possibly go there will desire to be a delegate. The best suggestion that I can make, therefore, is, that a special meeting of the Association shall be called, to be held at Atlanta some time during the month of October, and that arrangements be made for the commutation of fares, and perhaps for an excursion-train of Pullman cars that can be shunted off upon the park in which the exposition is to be held, so that you can live in your own cars. That will be a matter of ten days' excursion perhaps. That is rather an audacious proposition; but I think, as you examine the subject, you will find that it is fully warranted. Aside from that, as official action, it might be well to appoint certain members as delegates, who shall be specially charged with reporting upon whatever of novelty or improvement there may be exhibited there.

Upon the general subject, pending the election of officers, this seems to be as good a time as any to say a few words. You are yourselves responsible, as I have stated to you by circular, for the fact that the exposition is to be held at all; and I am going to put the responsibility upon you. You have had the audacity to complain of the method of ginning cotton; and you have taken part in one of the many undertakings with which I have been conversant in trying to get tare, and have the mode of cleaning cotton remedied. Here is a radical remedy proposed to you: to have the cotton so well handled and so well prepared

that you won't ask any tare; and it may happen presently that that condition of things will come about. The exhibition will be held at a very opportune moment. Its main purpose in its original suggestion was improvement of the cotton as it is delivered to you in the bale. It has gone beyond that. That improvement will be almost forced upon the Southern cotton-grower and Southern dealer by the probable conditions that will ensue on the next crop. You can all of you imagine what would have been the condition of the cotton-market this year in respect to the lot of trash which constitutes so large a portion of this crop had the picking season been as good as it was last year. The boot would have been on the other leg. Instead of being obliged to buy cotton as you could get it, you would have had your choice of time and of quality, as you may and probably will have choice of time and quality next year on the larger planting that is now growing, and on the large crop that may ensue. You are witnessing to-day probably a greater difference between the price of good cotton and poor cotton than most of us have ever seen before. It carries me back twenty-five or thirty years to find as great a difference. The schoolmaster that has whipped many of your mills into good shape during the last years of depression — the schoolmaster of hard times, which has caused great improvement in the processes of spinning and weaving — will come to the South; and when the schoolmaster whips the Southern cotton-grower and Southern cotton-dealer into putting up their cotton in good condition in order that they may be able to sell it at all, you won't have to cry out for tare much longer. That condition of things is likely to come, and the precise methods and ways of improvement will be concentrated at the right moment to be studied and adopted in the cotton exhibition at Atlanta. After the report of the committee, I will say a few more words.

At this point the Nominating Committee submitted their report, which was accepted; and the following gentlemen were elected: —

OFFICERS OF THE ASSOCIATION.

President. — JOHN KILBURN, Lowell, Mass.

Vice-Presidents. — WILLIAM F. GOULDING, Lewiston, Me.; RICHARD GARSED, Philadelphia, Penn.

DIRECTORS.

David J. Johnston	Cohoes, N.Y.
Charles L. Lovering	Taunton, Mass.
William H. Jennings	Fall River, Mass.
Charles D. McDuffie	Manchester, N.H.
Walter E. Parker	Lawrence, Mass.
John W. Danielson	Providence, R I.

Mr. Atkinson then resumed his remarks as follows:—

I would say, gentlemen, that the number of machines, and of methods of preparing cotton for the cotton-gin, taking the dirt out before it is placed in the gin, is much greater, and they are much more effective than I dreamed of a year ago; and the method of ginning is constantly being improved, and some of the roller-gins are now being introduced. Mr. William Dobson is now travelling through the South, introducing their roller-gins. I won't go into these details now, but will treat them further, after the subjects assigned for to-day are exhausted. I will say this, however, that the exhibition has gone beyond any thing I expected. In addition to the preparatory mechanical department, and improvements for handling cotton, there will be a very large and full exhibition of cotton-machinery for spinning and weaving. There will be an exhibition building modelled after that of the Kansas and Colorado building at the Centennial, in which will be gathered specimens of the ores, minerals, and timber, the oils and agricultural products of that great middle section lying along that mountain-range that I have had occasion recently to describe as the backbone of the eastern part of the country, three-fourths as large as France, and twice or three times as large as Great Britain. It is a section which possesses agricultural possibilities equal to either, and an abundance of coal, iron ore, and minerals of almost all useful kinds, in excess of both combined; yet inhabited, especially in the north-eastern part of Kentucky, by a sparse population, many of whom have never seen a wheeled vehicle, many of whom had never seen a black man until the servant of Professor Shaler went into that section with him. Old English customs that belong to the seventeenth century still survive among these people, although they are extinct in England. They have lived absolutely isolated and independent, buying from abroad only the steel needles that they use; their means

of transit from one section to the other being little mountain-bulls with pack-saddles; yet inhabiting a country of vast area, in which Massachusetts could be sunk and covered up once or twice over, and possessing a climate in the interior valleys of that section probably unequalled on this continent.

In this auxiliary building at Atlanta will be gathered the evidence that will turn the tide, or a part of the tide, of emigration into this *terra incognita* of the eastern part of the United States. I think you cannot afford to stay away from there.

The need of money has gone beyond what was at first thought would be sufficient. One hundred thousand dollars was thought to be enough; but it is found that two hundred thousand dollars will be required. The first one hundred thousand dollars is more than subscribed. There has been a disappointment in New England that perhaps might have beer expected. The gentlemen in Boston, who are always ready and willing and able to meet a claim of this sort, had the New England Manufacturers' and Mechanics'- Institute on their hands, with an investment out here on the Back Bay of some two hundred thousand or three hundred thousand dollars, and therefore there has not been that response from New England that had been hoped for. It won't make any difference, except to New England. Other cities have responded in larger degree than was expected, or there was any reason to hope. The money will be raised, and the enterprise carried out: but, as an expression of interest and good will, I am disappointed in the response from New England; and I present this matter in that aspect to the members of this Association, whether they will not sustain this project by the average subscription of a single share of one hundred dollars, of which there is more than a fair chance that they will receive back the whole. Yet I would not advise them to subscribe without the expectation of losing one-half. As an expression of good will, I think they should make that subscription. I submit that to you, not soliciting, but stating it. Mr. Christie, the Assistant Secretary of the Association, is here. The plans can be all fully explained, and perhaps, after the regular business of the Association is gone through with, something more may be said upon this point; but I take this early opportunity to make the suggestion to you, hoping it may result in such money expression of good will as

will keep up the New England end of an enterprise, which I cannot but think will be a starting-point for greater advantages, and greater profit from these advantages to the cotton-grower and the Northern manufacturer than could have happened from any incident of the last fifty years.

In respect to handling cotton, my own observation, confirmed by Mr. Goulding, jun., is this: that the capital invested in cotton-ginning, cotton-pressing, and baling, is probably equal to one-half the entire capital in all the cotton and spinning and weaving mills of the United States. It is probably not less than sixty million dollars. Yet it is not too much to say, that, in respect to power, twice the power is used that ought to be required; and, in respect to labor, twice the number of hands are employed to do the work in the worst manner that ought to be necessary; and it is safe to say, that nine bales out of every ten are depreciated after being picked, and before you get them, at least ten per cent, or one cent a pound. Whatever may have been the cause, the cotton-grower, cotton-ginner, and cotton-planter have been kept back in their progress at least half a century; and in the present decade are to be concentrated the inventions and improvements that ought to have been spread over half a century, and that have been spread over a whole century in respect to spinning and weaving. There will be greater profit in the next ten years, in preparing the cotton for your use, than there will be in spinning and weaving it; and there will be an opportunity for co-operation and profit in that southern section of the land which will unite the two heretofore divided sections of the Kingdom of Cotton into one solid unity that will be more effective in breaking the solid South, and in uniting the two sections of our common country, than all the talk of all the senators of the United States in their wrangle over who shall be sergeant-at-arms, and who shall have the offices of the Senate of the United States.

The PRESIDENT. The next item of business will be to take action upon the amendment to the By-laws, proposed by Mr. Pennell.

Mr. PENNELL. Mr. President, it will be remembered, that, at the last regular meeting of the Association, during the afternoon session, there was quite a discussion upon the eighth article, and that the suggestion by the Chairman and others as to the advisability of an amendment, led to a notice, in writing,

that one would be presented at this meeting. In order that the original article and the one which I have to offer may be compared, I will read the old one first: —

"ART. 8. Any person of good moral character who now is, or hereafter may be, treasurer, agent, or superintendent of any cotton-mill, may become a member of this Association, upon his signing the By-laws and paying an admission fee of ten dollars, and an annual assessment not exceeding ten dollars. After the first meeting of the Association, and at any regular meeting thereafter, new members may be admitted upon the nomination of any member, he obtaining a majority of votes of the members present. Any member may withdraw from the Association at any regular meeting, upon payment of all arrearages, first giving notice of his intention so to do to the Secretary; and any member may be expelled *for cause* at any regular meeting, two-thirds of the members present voting therefor."

I would move you, Mr. President, to amend this article by striking out all of such article as precedes the reference to the withdrawal of members, and inserting instead the following: "Any person of good moral character who, at the time of his application for membership, is treasurer, agent, or superintendent of any cotton-manufacturing company, may become a member of this Association, if recommended," etc.; so that the amended article shall read as follows: —

"ART. 8. Any person of good moral character who, at the time of his application for membership, is treasurer, agent, or superintendent of any cotton-manufacturing company, may become a member of this Association, if recommended by a member and accepted by a majority of votes of the members present at any regular meeting, upon his signing the By-laws and the payment of an admission fee of ten dollars, and such annual assessment as may be hereafter agreed upon, not exceeding ten dollars. Any member may withdraw from the Association at any regular meeting upon payment of all arrearages, first giving notice of his intention so to do to the Secretary; and any member may be expelled *for cause* at any regular meeting, two-thirds of the members present voting therefor."

Mr. DRAPER. Mr. President, there has been, from the beginning of this Association, some little question as to the construction of Article 8. I think it is necessary to come to some definite understanding about it, as to whom the Association intends to invite to become members. I confess I am one of that class of men to whom this amendment would say, "If you were not already a member, we would not allow you to come in." Being in that position, I would like to inquire what the occasion is for keeping out all machine-makers, and all the men

who are interested in the objects of the Association and are connected with the making of machinery, or any thing of that sort. It does seem to me that there is much to be learned by the men that make the machinery, and the operators who are coming together and moving each other's views, as we have seen them. I know of. I have been in both those works, and have seen a measure between them, and I think I know something about them. It seems to me that membership in this Association might not to be confined strictly to that class of men to which this amendment would confine it. I am sure you want a large fund to use. There is no objection to people coming and listening respectfully to what might be said here; and it does seem to me, that, while you may want to guard against contamination from the admission of any improper characters, you might leave the question in this shape, and I think it would be a good way to leave it: that any one who is a treasurer, agent, or superintendent of a cotton-mill, may become a member, on the nomination of any member, by a majority vote. Any other individual who is interested enough to pay the proper amount of money may become a member, if nominated by the Board of Government: leaving your Board of Government to protect you against too great a number, or against individuals with whom, perhaps, you would not like to associate. This Article 4 is somewhat peculiar. It says, "Any person of good moral character who now is, or hereafter may be, treasurer, agent, or superintendent of any cotton-mill, may become a member of this Association upon his signing the By-laws and paying an admission fee of ten dollars, and an annual assessment not exceeding ten dollars." Now, then, any one of those men, at that time, could become members of their own accord. They need not ask anybody else whether they could become members or not; but, "after the first meeting of the Association," the article says, "and at any regular meeting thereafter, new members may be admitted upon the nomination of any member, he obtaining a majority of votes of the members present." That is, leave the Association to decide who are suitable individuals. Now, I was invited by members of the Board of Government to join this Association; in fact, I was urged to do so, very soon after it was instituted. And I called attention to this article; and I was told by Mr. Burke and by Mr. Straw, and others, that that

article was not intended at the time for any one but those who should form the nucleus of the society; and to show you that their action agreed with it, in 1866 the record says, "The following gentlemen, whose names were proposed for membership, were then elected members of the Association by unanimous vote," not by sufferance. Those names were Messrs. Josiah Brown, George Draper, William F. Draper, and William T. Horrobin. I believe neither of those four individuals was, at that time, either treasurer, agent, or superintendent of a cotton-mill, and every person who voted for them knew it. In the same meeting Mr. D. J. Johnston came into the Association. Now, if there is any reason why I should not be a member hereafter, there is a reason why I should not have been a member heretofore. I do not want to remain a member now simply upon sufferance. I am acquainted with all you gentlemen, and am very happy to meet you; but I will try and make myself as happy as possible if you do not want me, or do not want others like me. I think it will not be wise for this Association to exclude all such people. I think the records will show, shortly after the Association was formed (in 1868, I think), a letter from Daniel Williams, tendering his withdrawal from the Association for the reason that he was no longer engaged in cotton manufacturing. Another thing I would suggest, and that is: when one is a member, he should always remain a member, unless voted out for cause. Not that members should feel, the moment that they resign the office of treasurer, agent, or superintendent, they must drop their membership, but that they should be allowed to come here, if they want to do so, enough to pay the annual assessment. The record also shows this fact, that, when Daniel Williams tendered his withdrawal from membership, notwithstanding he would not be a member under the proposed amendment, the Association respectfully invited him to be present and participate in the future meetings of the Association. Now, I have said all I care to say at present; but I certainly feel a good deal of interest in the welfare of this Association, and have never endeavored to obtrude myself upon it. One thing I feel sure of, and that is: an efficient Board of Government can keep people in order, and not allow people to talk any very great length of time unless they are invited by them to do so. I wait for any further expression from the gentlemen.

Mr. GARSED. I second the resolution, to get it properly before the meeting.

Mr. DRAPER. Perhaps it might be well enough to say, in addition to what I have said, that Mr. Atkinson, who has done so much for us, would come in the same category with myself. I know he expressed to me the same feeling that I have on this subject.

Mr. ATKINSON. Mr. President, I did not intend to intervene at this time in this discussion. The epitaph written over many associations has been, "Died under the obstruction of its own by-laws." The passage of this resolution would be a hint to many of us who are qualified by what we do not know, but desire to learn, to be members of the Association, to withdraw. That is my position. I think the passage of this resolution, in view of the history of the Association, would be inexpedient. It has always seemed to me, that, if the Board of Government would lay out the work of the morning, assign the specific discussion to persons perfectly competent to take part in it, whom they can easily select, and use the discretion ordinarily lying in the hands of the presiding officer to guide the discussion, the morning discussion may be confined to determined points, and be extremely useful. Then I would open the afternoon discussion to anybody and everybody, patentee or otherwise. You cannot afford not to know what patentees have got. If you do not know what the patents cover, you cannot spin cotton or weave cotton, or do any other part of the work. It is the best line you could open, it seems to me, after the regular work is finished, to let every patentee come and present his own side, and all the rest of you break him up, if you can, by asking questions. Nothing is good for any thing until it has been torn to pieces and made over, not even a speech. I therefore suggest, sir, as a substitute (I should not have done this at this time if Mr. Draper had not called me out), that all nominations for membership shall be made in writing at least one week before the date of any regular meeting, and shall be considered by the Board of Government, and reported to the meeting favorably or adversely for the action of the Association, provided, that in case the Board shall decide to report adversely upon any nomination, the member who shall have made it shall be informed of the intention so to report in order that he may have an opportunity to withdraw the name. It seems to me that in that

manner you can control the admission of members in the most suitable way, and you will not be in danger of dying by the obstruction of your own By-laws.

Mr. GARSED. If we do not alter this law, we must change the name of the Association. The matter was brought out during the last meeting in consequence of a gentleman's name being proposed as an engineer. The President called attention to the By-laws at the time, and most of those present remember the unpleasant scene when the gentleman was refused admission. Mr. Draper takes too individual a view of this resolution. There is not a thing in it intended or implied that asks a gentleman to withdraw. The suggestion is made that we should admit machinists, and listen to their views upon machinery that is going to be put in use. But these meetings are not, if I understand the matter, for the purpose of discussing patent rights. We can try the machines in the mill first, and then discuss them afterwards with a great deal more freedom in the absence of the machinist or patentee, because it must be remembered that there are some young men here that have a little diffidence in getting on the floor and discussing these matters in the presence of the men who have got up the inventions. We must change the name of the Association, and call it the Cotton Manufacturers', Engineers', Architects', and Machinists' Association. This by-law is intended to limit membership to persons engaged in the trade. We all remember that two or three years ago we had a discussion here that looked like running into unpleasantness between two rival machinists. It seems to me that this is not the place to discuss rival machines, nor to listen to the men who have invented them. The inventor believes in his machine as he would believe in any thing he was the father of. What we want to do is, to give the young men an opportunity to get up and say whether they do or do not approve of it, without having the feeling that they are making some man unhappy because they do not agree with him as to some particular machine. I do not see why Mr. Atkinson should withdraw. There is nothing in the proposed by-law that requires it. There is an ambiguity in the present by-law that needs to be remedied in some way. When a gentleman comes before this meeting applying for membership, and is refused, it certainly makes him feel very unpleasant; and we propose now to unload that responsibility from the Association,

and put it on the Board of Government. I really cannot understand the objection to Mr. Pennell's amendment.

Mr. ATKINSON. The only point in my mind is, to take the usual course in all societies, of referring nominations for membership to a committee. There need be no unpleasantness. If, after an adverse report, a member sees fit to press his nomination, he then takes his chances before the Association.

Mr. PENNELL. In preparing the amendment, I did not intend to cast any reflection upon the old members of the Association.

Mr. ATKINSON. I do not take it so.

Mr. PENNELL. I should be very loath to have Mr. Atkinson or any other member withdraw. We have some valuable members here who are not cotton manufacturers, from whom we get very valuable information; but it was thought advisable at the last meeting to draw the line somewhere, and, in looking this matter over carefully, this was the only way I could see out of the difficulty.

Mr. GOULDING. The object of Mr. Garsed's motion was the acceptance of the report of the committee in order to bring it properly before the Association. That vote should be passed, I think, and then Mr. Atkinson's motion will be in order. I rise to suggest that the Secretary, by leave of the Association, should read the title of this Association, and the object of its formation as stated in the first part of the Constitution, that we may better understand what we are firing at.

The PRESIDENT. The motion before the house is the amendment of Mr. Atkinson to the proposed amendment of the By-laws by Mr. Pennell.

Mr. ATKINSON. I offered my motion as a substitute for Mr. Pennell's; but I will not offer it myself, as I am one of those who would not be eligible as a member at the present time under Mr. Pennell's amendment. I therefore do not offer it; but I have it written, and, if anybody else chooses to offer it, it may be brought before the meeting.

Mr. PENNELL. I simply gave notice at the last meeting, that I would present an amendment at this meeting. In view of the unpleasant dilemma in which we found ourselves placed at that time, it seemed to me necessary to do something of the kind.

The PRESIDENT. The question before us is the amendment

offered by Mr. Pennell. Does any gentleman desire to hear it read again?

[At the request of one of the members, Mr. Pennell's amendment was read.].

Mr. WEEKS. I move to amend that by substituting the by-law presented by Mr. Atkinson, which is as follows: —

ART. 8. All nominations for membership shall be made in writing, at least one week before the date of any regular meeting, and shall be considered by the Board of Government, and reported to the meeting favorably or adversely for the action of the Association; provided, that, in case the Board shall decide to report adversely upon any nomination, the member who shall have made it shall be informed of the intention so to report, in order that he may have an opportunity to withdraw the name.

The PRESIDENT. Gentlemen, you hear the amendment offered by Mr. Weeks. I would call your attention, before calling for a vote upon this subject, to the fact that it requires a two-thirds vote to amend the By-laws, and of course it would require the same vote upon this amendment. All that are in favor of the amendment offered by Mr. Weeks, will please manifest it by saying "Ay."

[The vote was taken, and the President declared the amendment accepted.]

The PRESIDENT. The next question will be upon the adoption of the by-law as amended by Mr. Weeks.

Mr. PENNELL. Before that motion is put, I would inquire if there was not a request made of the Secretary a while ago in regard to reading the preamble which sets forth the objects of the Association. Would that be in order now?

The PRESIDENT. No objection being made, the preamble will be read.

The Secretary read the preamble as follows: —

"The undersigned, Agents and Managers of Cotton-Mills in New England, desirous of promoting a more intimate acquaintance with each other, and of collecting and imparting information as to the best methods of manufacturing cotton, hereby form themselves into an Association by the name of the "New England Cotton Manufacturers' Association," and adopt the following By-laws for its government, pledging themselves, each to the other, to abide by the same until altered or repealed."

Mr. DRAPER. Mr. President, having been familiar with this Association for a long time, I want to say that the very fact that it was called the "New England Cotton Manufacturers'

Association" was a stumbling-block for quite a long while. Questions were raised whether gentlemen from other States should be admitted or not, because it was a New England Association. I believe we have got bravely over that, and are glad to welcome people from all parts of our broad land. As to telling who are or who are not suitable persons to teach the cotton manufacturers that which they want to know, I will say that I have a very large interest in cotton manufacturing. I am an owner of stocks in a great many different cotton-mills, and propose very soon to have a cotton-mill of my own, where I can be appointed superintendent or treasurer or agent. Now, I want to know how much difference it would make to you whether I shall be a member in the condition I am in now, or whether I shall apply for membership after I put myself in that position. Now the matter is just where it should be. We have a Board of Government, and I have great confidence in their wisdom. They will not, in my judgment, recommend people for membership that will not be useful in the Association; and I hope the amendment will prevail.

The PRESIDENT. The Chair would be inclined to rule that both Mr. Draper and Mr. Atkinson *are mill-managers.*

Mr. ATKINSON. It will not be necessary to change the preamble, but simply to say that certain persons, being agents and managers of cotton-mills, combine together for the purpose of promoting a more intimate acquaintance with each other, and of collecting and imparting information as to the best modes of manufacturing cotton, and, in order to carry out the second purpose, propose to admit treasurers and patentees. They are not excluded. It is a declaratory clause; and they saw fit, having declared themselves an Association, to let in some outside barbarians, who, though not knowing any thing themselves, might bring out what the superintendents and agents did know. Some of us have performed that duty pretty well.

Mr. PENNELL. I wish to explain my position a little more fully in regard to the amendment I offered. The phraseology of the old Article 8 has always been a stumbling-block to some, and very objectionable to many; and inasmuch as this objection exists, and unpleasant discussions have heretofore taken place and may again, I concluded it a judicious thing to do, to avoid the recurrence by substituting such an amendment as I have presented this morning. However, I am perfectly willing to let

this matter of new members be referred to the Board of Government for their acceptance or rejection; and, if it is not too late, I would withdraw that amendment.

The PRESIDENT. Mr. Pennell having withdrawn his amendment, the amendment proposed by Mr. Weeks is now before the house.

Mr. GARSED. Still, there is an ambiguity. The Board of Government are simply to refer the matter back to the house. Let us make this by-law understood in some way. I do not care how it is done.

Mr. CHARLES NOURSE. If the gentleman has withdrawn his motion, there is no motion before the house. Am I correct, sir?

The PRESIDENT. It all falls together. You are right.

A MEMBER. Mr. President, I think it is too late to withdraw the resolution after the amendment to it has been adopted, unless it be by general consent of the Association.

Mr. PENNELL. Let it go, Mr. President.

Mr. ATKINSON. Mr. Pennell offered a resolution of amendment. Mr. Weeks offered his motion as a substitute, which has been adopted. When I proposed it at first, it was as a substitute; and afterwards, it seeming improper for me to propose it, Mr. Weeks offered it, and I assume Mr. Weeks intended it as a substitute. It has been voted on, either as an amendment or substitute; and it is now before the meeting for adoption or rejection, I should say. If the meeting declares in favor of its adoption, well and good; if it rejects it, then the whole matter can be laid on the table.

The PRESIDENT. The Chair would rule that the question before the house is the amendment offered by Mr. Weeks.

Mr. C. I. BARKER. I move that this whole subject be referred to the Board of Government, to be reported on at the next meeting of the Association. It seems to me that any action taken to-day would be premature, and that we shall make a mistake if we proceed in this way.

Mr. GOULDING. I hope that motion will not prevail. Notice has been given of this amendment of the By-laws. We are all satisfied with Mr. Atkinson's proposition or the other. Mr. Pennell's has the advantage of being consistent with the title of the Association. I do not know that the other is at all inconsistent with it. It has been our custom to admit members

here outside of the list of agents, superintendents, and treasurers; and no particular harm has come of it. The question was agitated originally in the Board of Government in relation to the looseness with which names were proposed here and admitted, and it was thought best to look at the article. We did so, and found this incongruous language in relation to making members; and it was thought it ought to be improved in some way. The subject was brought here by trying to make an engineer a member of this Association, and the matter has taken this course. I think either of these by-laws will be an improvement upon the present condition of affairs, because it leaves the question of introducing men outside of those who are included under the title of the Association with the Board of Government. A suggestion had occurred to me, that persons who are not agents, superintendents, or treasurers could be made honorary members, so that they might be with us, and bring in their views when asked or desired, but leaving it with the Board of Government to discriminate. For a man to come in, simply because he wants to, is hardly a good reason; but, if he has distinguished himself in art or science, it would be an honor to the institution to have him join us. I think the by-law before the house should be adopted without delay.

Mr. DRAPER. A single word. It seems to me that there was no amendment submitted to the members. They did not know when they came here what shape the amendment would come in, and we could not tell whether we were in favor of it or not. Now, I think we can test the views of the members by putting this amendment of Mr. Weeks, which I think is just the thing, to vote; and then it might be referred to the Board of Government, to bring in such an alteration in the 8th article of the By-laws as might be necessary to embody that amendment at the next meeting: but it seems to me we ought to ascertain the members' opinions now.

Mr. PENNELL. I did not expect, in preparing my amendment, to express the view of every member of this Association, by any means. It was my endeavor to prepare an amendment which would be consistent with the preamble. If the majority of the members think differently from what I did, I have no more to say.

[Mr. Barker's motion to refer this whole matter to the Board of Government was put, and was lost. The question was then

taken on the amendment of Mr. Weeks, and the amendment was adopted.]

The President then called Vice-President Goulding to the chair, and read the following paper: —

CARDING.

BY JOHN KILBURN, ESQ.

At the request of your Board of Government, I have collected and prepared for your considerations a few thoughts that have occurred to me, together with such ideas as I have been able to glean from other minds, relative to the two systems of single and double carding ordinarily used in the manufacture of cotton yarns for cloth.

This subject of carding has been so fully and ably presented to you in the past, that I fear I shall not be able to convey to your minds much that will be new or of special interest: but I hope to be able to so introduce the subject that much valuable information may be derived from the discussions which may follow; and I ask your indulgence for relating some of my own experience, which I am compelled to do to convey some of the ideas I wish to elucidate.

Having seen good results produced from a multitude of different arrangements of clothing, with great variations in the number of points of wire per square foot, and also in the size of wire used, and in the various modes of adjustment of cards, I do not propose to touch upon matters of that sort, but to leave them to be determined by the caprice or intelligence of users, and the character of the work to be done, and to confine myself wholly to the merits and demerits of single and double carding.

Both systems have been successfully used, and each has numerous friends and supporters: but the question which is best, must, in my judgment, be determined by the character, quantity, and quality of the work to be done and the material from which it is to be made; and no definite rule can be established until these things are known.

I have had more experience with single than with double carding, and it has led me to the following conclusions: First, If goods are to be made for the brown market, from yarns ranging from 12 to 20, and of ordinary counts, there is no difficulty in making yarns that will weave well with single carding and a small number of cards in a section, as the variation of three or four numbers is not sufficient to materially affect the weaving of such yarns: but, if goods so made are brought into

competition with those made from cotton twice carded, the cotton carded once must be a full half-grade or more above that carded twice, and this frequently increases the cost of cotton one-half cent per pound; and with this difference, which neutralizes any advantage gained from carding once rather than twice, a good judge of cloth, who is a sharp buyer, will give a preference for the goods made from double carding, provided equal skill is used in their manufacture, unless the single carding is excessively light; but, if these two products were made from the same stock and were afterwards bleached, the differences named would be materially reduced.

Second, If goods are to be made for brown market, with single carding, from yarns ranging from Nos. 20 to 40, and closely woven, much attention must be given to the selection of cotton as to grade and staple, or you will lose much more in other departments than the difference in the cost between the two systems of carding. As, for instance, if you purchased cottons at random, and should mix harsh, brashy cottons, like those sometimes obtained from Selma, with nice Memphis or New Orleans cottons, for, say, No. 27 warp, I think you would produce yarns that would work sufficiently bad to suit those buyers who think any cotton is good enough, if they can obtain a concession in price of one-quarter of a cent per pound; and I attribute the bad results from such a mixture to single carding; for, if the same mixture were put through two operations of carding, good, even yarn would be produced. I account for the difference in results from the above-described mixture and systems of treatment, by the fact that fine New Orleans or Memphis cottons may be subdued so as to draw evenly by once carding, while the brashy Selma would require two operations to subdue it, so as to make it draw evenly with the finer staples, which would not be injured by two operations. I have had several tests of cotton so mixed. In 1865 I was asked to use, in the mills I then had charge of, as large a proportion of India cotton as possible, the cleanest and best-stapled Surat having been selected for the purpose; and I at once commenced mixing the India, or Surat, cotton with soft American cottons, in a mill which had double carding for two-thirds of its capacity. Stock so mixed, and put through two operations of carding, worked much better than I expected it would: and, encouraged by this result, I extended the use of Surats, so mixed, to a small room,

with single carding, which had been especially arranged for working variable staples or waste; and the result was, that I produced yarns so excessively uneven that I could do nothing with them. This result led to a thorough investigation, by which I concluded that my difficulty came from the difference in the nature of the two cottons; the American being fine and silky, while the Surat was coarse, brashy, and bulky. I therefore made laps from clear Surat, removed the calender-rolls from one railway-head, passed it through the railway-head in a sliver as wide as the boss of the rolls, and deposited it in cans: it was then put through the lapper again, and mixed with American cotton; and the two cottons thus mixed were made into yarn which was quite even, and which worked satisfactorily. I then tried to make yarn for goods to be bleached or colored, from clear Surat with single carding, and succeeded so well with it that I ran nearly twenty thousand spindles on Surat cotton for four months, by making my warp two numbers coarser, reducing, say, from No. 27 to No. 25, and increasing the weight of my goods to that extent. While this was being done, we received some cotton from India of too low a grade for single carding. We therefore put it through two openers with trunks, and through our regular system of picking, eight beaters, then put it through our double carding, and made from it a new style of goods, from No. 18½ warp and No. 21½ filling, which were so satisfactory to purchasers that they acquired quite a reputation before this stock was exhausted, and hence we bought more; but the termination of the war brought down the price of American cotton, so that we were obliged to stop the consumption of Surat. We therefore continued to make this new style of cloth from American cotton; but we found it very difficult to maintain our position in the market, on account of the bulky feeling of goods made from Surat, and we were frequently accused of reducing the weight of our goods when no change had been made. I mention this incident to illustrate more fully the difference in the nature of cottons, and the treatment they need, and the necessity of carefully selecting for single carding.

After making the before-mentioned new style of goods for several years from American cotton and double carding, we were compelled to apply our double carding to other goods requiring special care; and, therefore, we were forced to make the new style, which was sold in the brown, from single carding.

This we tried to do from the same grade of cotton that we had been carding twice: but we were soon met with such bitter and long-continued complaints from our customers, that we were forced to try a half-grade better cotton; and this only modifying our position, we finally raised the cotton another half-grade. This served our purpose for a time; but when the hard times came on, and competition became sharp, we were forced to put in the second operation of carding, or take a secondary position in the market. I think our cards were not overloaded, as we were carding one pound per inch single, where we had carded one and one-half pounds per inch on double, carding; yet I frequently tried and could distinguish the goods made by the two systems, by their feeling, with my eyes closed. Therefore my third conclusion is, that, to insure success when trade is dull, all goods for the brown market (specialties excepted) should be made from double carding.

Fourth, For yarns above No. 20, I do not think the ordinary arrangement of single-carding mills affords a sufficient number of doublings to insure yarn good enough to make into goods more difficult to weave than print or kindred cloths: therefore the larger the number of cards in a section for single carding, the better the work, provided the sliver delivered at the railway-head is not too heavy; as the evenness of the work is increased by the doublings, and, in making fine yarns, the benefit of doublings is realized in a twofold ratio as the numbers of the yarn are increased. Hence, if I were called upon to arrange a single-carding mill, to make yarns ranging from Nos. 30 to 40, I should be inclined to put in cards under, rather than over, thirty inches wide, to avail myself of the increase of doublings to be obtained from narrow cards without making a heavy sliver. But I regard this matter of doubling of so much importance, that I would never advise any one to attempt to make yarns ranging from Nos. 30 to 40, to be woven into any thing which would be called hard or difficult weaving, without double carding, on account of the doublings derived from the two operations of carding, if for no other reason, as this advantage in making even running yarns is very great. It would be almost impossible to make, successfully, yarns ranging from Nos. 40 to 60, from short-staple cotton, without double carding, even if you did not take into account their weaving qualities, unless combing, or some other mode of securing the necessary doub-

lings were adopted. I find strong evidence of the value of doublings in the fine mills of England as well as those of our own country; and I would here like to call attention to the wide difference in the doublings between single and double carding, also between the doublings of ordinary double-carding mills and those arranged for fine work, and compare them with mills fitted with combing machinery, and other appliances for making the best of fine yarns.

In making the above comparisons, let us assume that these mills are all arranged in the best way for the work they are designed to do: and let A represent a single-carding mill with cards deemed capable of handling a large quantity of cotton: let B represent a single-carding mill with cards deemed capable of handling a medium quantity of cotton; let C represent a single-carding mill with cards deemed capable of handling a small quantity of cotton; let D represent an ordinary double-carding mill; let E represent a good double-carding mill for Nos. 30 to 40 yarns; let F represent a good double-carding mill for Nos. 50 to 70 yarns; let G represent a double-carding mill fitted for fine work, say for No. 90 yarn; let H represent a mill fitted with combers to make Nos. 100 to 150 yarns; let I represent an English mill with combers making No. 80 warp and No. 110 filling:—

Then, by reference to the following table, you will see the organization of each mill and the total doublings:—

	Picker.	Breaker-Card.	Finisher-Card.	Comber.	Doubler.	Drawing-Frames. 1.	2.	3.	4.	5.	6.	Roving Processes. 1.	2.	3.	4.	Spinning.	Total Doublings.
A	3	–	7		–	3	3		–	–	–	–	2	2	–	–	756
B	3	–	0		–	3	3		–	–	–	–	2	2	–	–	1,080
C	3	–	2		–	3	3		–	–	–	–	2	2	–	–	1,296
D	3	60			–	3	3		–	–	–	–	2	2	–	–	64,800
E	3	94	0		–	3	3		–	–	–	–	2	2	–	–	101,520
F	3	94			–	3	3		–	–	–	–	2	2	2	2	406,080
G	4	8	8	–	60	3	3	–	–	–	–	–	2	2	2	2	2,211,840
H		–	8	6	14	6	6	3	–	–	–	–	2	2	2	2	1,161,216
I	3	–	–	6	14	8	6	8	8	8	6	–	–	–	–	2	74,317,824

By the foregoing comparisons I do not wish to convey the idea that I consider the doubling on cards equal in importance to those on drawing, speeders, and spinning; but, taking into

account the large number obtained at a small expense for labor, I deem them of great value.

My final conclusion is, that, owing to the large amount of doublings cheaply obtained from double carding, and the increased cleaning and subduing power of two operations over one, coupled with the fact that two operations permit manufacturers to vary the grades of cotton purchased, materially, without hazarding the reputation of their goods; and, as the difference in value between a high and a medium or low grade of cotton frequently amounts to a profit, owing to the great changes in the quality of the cotton-crops from year to year, and from the beginning to the end of succeeding seasons, I prefer to take *my chances* of *success* in manufacturing and in earning *dividends* with *two* operations of *carding*, rather than *one*.

Mr. DRAPER. Mr. President, I merely wish briefly to state a fact which I think is pertinent to the question. I do not expect it is possible for the people to believe what I say to be true; and yet I intend to tell the truth, and nothing but the truth. I have seen within a fortnight a small mill of one hundred looms running on print goods. I have known it for twenty or thirty years. The goods were 56 × 60. I had occasion to go there. A party has taken hold of the mill, and started it up on this plan. I can show you a sample of the cotton and a sample of the yarn. They were using cotton that cost less than eleven cents a pound, of poor quality; and the looms, running one hundred and eighty-five picks, were running steadily and nicely. I found the warp-spinning, which averaged finer than 28, running one hundred and sixteen turns on the front roll, and running well. I found two filling-frames there that were running one hundred and twenty-three turns on the front roll, and running well on No. 36 filling, and finer. The mill had but ninety-six doublings. The principal peculiarities about the mill are, in the first place, the entire absence of any drawing-frames; and, when they get to the spinning, they simply use the roving of ordinary size, and in the room of drawing it nine, they just use double roving, and draw it eighteen; and it is producing the most astonishing results. I wanted to see how far they could carry the joke, and they brought me some yarn spun from upward of twenty-six draught; and, from that poor cotton, I was told the breakage was seven pounds above the super-extra English standard, even under those conditions. I think it foreshadows an impending revolution in cotton-spinning on low grades. I could show you some of that yarn, and the breakages from it, which were perfectly astonishing.

The PRESIDENT. You being a weaver, I should prefer to have you weave the yarn rather than weave it myself.

Mr. DRAPER. As far as that is concerned, I am ready to admit the difficulty: but the yarn was of too low twist to be woven on such grades of goods as I am speaking of; but on such as they were, weaving 56 × 60, — a low grade of weaving, — the weaving was running first-rate; and I think, if I should submit the yarn and the cotton to you, you would be surprised at the result. I am interested in it as a cotton-spinner, because I have stock in a new mill which is about starting up,

and parties are advising with me about it as an owner, and not as a patentee.

Mr. LEIGH. Mr. President, in regard to doubling the strength of yarns, I notice on your board, there, two mills that I think I have seen in England. In one case, they have six sets of drawing-frames. They are making from 80 to 110; and the peculiarity is, they have only one doubling in the spinning; no doubling in the roving-frame. The last one is the one I refer to. They both belong to the same firm. They have two mills fitted up with the usual number of doublings, and double in roving-frames; only three sets of drawing-frames. I saw them both, but the last mill is peculiar. In the first place, they double three in the picker; they double six on the two drawing-frames; the carding is single. They double fourteen on the comber. They then take it to a drawing-frame, and double eight. They then take it to another drawing-frame, and double six; and so on until it has passed through six drawing-frames. It goes single to the slubber, and single to the roving-frame, and double in the mule; and by that means they got 74,317,824 doublings. The mills are about 60,000 spindles each. They make yarns for thread which have to be very carefully made, as they are liable to be rejected. In the latter mill, with all the doublings, and with so many drawing-frames and so very few roving-frames, they make a superior quality of yarn. There has never been any of it returned on their hands, whereas in the other mills they have frequent cause of complaint. In regard to the cost, I think the cost is two cents a pound less for the carding-room; that is to say, it costs less to put it through six drawing-frames and two speeders, than four drawing-frames and four speeders. The machinery costs less money: there is less waste; less room and power are taken, and the plan in every way is satisfactory; so much so that they are altering the other mills on the same principle; and that follows out your suggestion, that doublings are very essential to good work.

The PRESIDENT. Mr. Leigh is right in regard to the last mill, but the other is not an English mill. There may be a similarity between them.

Mr. KENT. Mr. President, I notice Mr. O. S. Brown is here, who is running very successfully indeed without any drawing whatever. I know he is a very modest sort of a man: but still, when you get him harnessed in, he can handle a cotton-mill as well as anybody; and I would like to hear from him.

Mr. BROWN. Gentlemen, I am not a member of your Association, I am sorry to say; and I have not come prepared to say any thing about the use of drawing. I did not expect to be called upon at all. All I can say is, we have taken the drawing out of the Salmon Falls Mill, and make yarn from 27 to 50; and it works very nicely with us.

The PRESIDENT. The Board of Government invited Mr. Brown to address the meeting on the subject; but he declined, I am sorry to say. I hope at a future time he will do so.

A gentleman asked Mr. Brown how many doubles he got on 50 yarn. Mr. Brown gave the various doublings he used, and the President stated that they amounted to 4,968.

Mr. HIGGINS. Twenty-nine years ago this coming season I started a small cotton-mill. I started it with double carding; afterwards, finding my cards not sufficient for the amount of work required, I changed to single carding. I ran ten cards together. I had one operation of drawing, giving a total doubling of forty. I made print goods, with No. 25 warp, and 33 filling, and obtained excellent results for several years. Several years later I ran a much larger mill on No. 33 warp and 40 filling, having only two hundred and eight doublings, with single carding. I simply state the facts.

The PRESIDENT. I will say to the gentlemen present, I do not consider weaving yarns a test of their quality. When you make goods, say 96 by 112 or 120, you begin to test the qualities of fine yarn very seriously; and this larger number of doublings is undoubtedly designed for work of that sort, and also for thread-making. My first mill in the city of Providence was a single-carding mill, running on 34 warp and 36 filling. It ran well, and what little reputation I have acquired as a manufacturer is due to my success there; but it did not run as smoothly with me as double carding. We made three widths of cloth, — twenty-eight, thirty-four, and thirty-eight inches. If I had attempted to weave this same yarn into close goods, which I deem difficult to weave, I think my mission would have been a failure.

Mr. ATKINSON. I had the audacity, Mr. President, some time ago, in the early days of my membership, to ask some questions on this point, not knowing any thing about it myself. I then received the impression, which is confirmed to-day, that you will not clear up this question until the remedy for the griev-

ous fault in the cotton-mill is discovered, and that is, the true covering of the top-roll, either of the drawing-frame, railway-head, or spinning-frame. I submit, as a theorist, knowing nothing practically about it, whether these are not the conditions. Every inch of carding which you use, more than which is necessary to straighten the fibre, does some harm to each particular fibre of the cotton that you use: it may be little, and it may be much; but to some extent it impairs the quality of that fibre. You then draw the strand through certain machines before you begin to gain the twist. In order to draw in those machines in which there is no twist that helps hold fibre to fibre, you must put a heavy weight upon your top-roll, in order that you may draw the selvedge. In doing that, you impair the quality of the centre. You crush part in order to draw the whole; and that was admitted in previous discussions, that you could draw cotton through a drawing-frame so many times that the fibres would fall apart, and you could no longer spin it. I think that was admitted. I think it has been done. When you begin to draw them, and have gained a twist, you may lighten up your weight because you have no selvedge, and the twist helps hold the strands together. You may, therefore, lighten the weight on the top-roll, and still gain extension of your strand. I had the satisfaction, after that discussion, of having one practical spinner, who is not here to-day, a thoroughly skilful man, come to me at the next meeting, and state, as the result of that discussion, he had thrown out one-half of his drawing, and was making a great deal stronger yarn. Now, do you not work (I will put it in the form of an inquiry, so as not to appear to know any thing), do you not work under serious difficulties, owing to the imperfection of your top-roll? It is not the rib where your leather cot is joined that makes it necessary for you to put twice the weight upon your top-roll that is needed. Whenever you come to that rib, your top-roll is retarded in very slight degree; and, in order to overcome that retardation of the rotation of the top-roll, caused as it is by friction, you have to put on a heavy weight instead of a light one. We thought we had discovered a substitute for leather in the form of chrome-gelatine rolls, which worked in the cold weather. We did run spinning-frames at the Indian Orchard Mills at six pounds on the front roll, where we had ordinarily worked eighteen; and we made

eight per cent stronger yarn continuously by that change, and as even as it had been made before. That was the two hundred and forty-first patent on a substitute for leather: and it was as worthless as all the rest, because it would not work in dog-days. When the original leather top is displaced by an elastic homogeneous substance without a rib, will you not then be in a condition, as you are not now, to determine whether more carding is best, or whether you had better gain your extension on your twisted strand, rather than use a drawing-frame, delivering a flat or untwisted strand? The result of all my questioning, without any practical experience or knowledge, was to bring the conviction to my mind that a greater elimination of the drawing would be an improvement, that you would gain your doubling on the card and on the rovings, reducing the drawing to the lowest possible point, in order to avoid that excessive weight on the top-roll. I simply submit these questions; for, of course, I have no practical knowledge on the subject. Theoretically, it seems to me that the cotton-fibre must be more injured by drawing the fibres apart, under the crushing effect of heavy weights on the top-roll, than by any other treatment. Hence, the strongest yarn will be had from small strands worked under very light weights, the evenness of the strand being secured by the greatest number of doublings. Heavy grists and heavy weights must take all the life out of the cotton.

Mr. E. M. SHAW. I have had no practical experience in this matter of no drawing, but I have given a good deal of attention to it. I have watched with a good deal of interest the mill Mr. Brown speaks of. I have seen some of his work running with 96 picks of warp and 100 picks of filling made by the process he speaks of. It is something different on those 56–60's. I have been through the mill many times, and I do not know a mill that runs prettier from carding-room to weaving-room than this. Whether his success is to be attributed to no drawing, or double or single drawing, I do not know. Mr. Greene is here from Brunswick, Me., who has remodelled part of his mill, and now runs only one head of drawing; and I would like to have the result of his experience. In conversation with me yesterday, he made some statements which I think are important; and I would like to have him state to us how he works in his mill.

Mr. GREENE. We started our new card-room about four weeks since, with double carding and seven cards to a railway-head, with the sliver about eighty grains to the yard at the railway-head and one process of drawing, which we think makes stronger yarn than to have ten or twelve cards to a railway-head and have two processes of drawing, with sliver from railway-head 100 to 115 grains per yard.

Mr. DRAPER. I rise to say that the mill which I spoke of up at Kinderhook is owned by Mr. Handy, who is the agent of the Manville Mills, where they spin yarn up to 80's; and quite a large portion of his work up to 80 is running without any drawing at all, and running somewhat on the same principle of the mill I mentioned. It was his experience on the Manville Mill, after experimenting on this matter, that led him to reject the drawing, and then double the roving in all cases; drawing excessively at the spinning-frame, so as to keep up the size of the roving. The great advantage to come from this impending revolution I spoke of, is in the fact that you are going to save a very large expense in roving machinery. If you can use roving twice as coarse, it will cost you very much less to make it; because on coarse roving you use machines that will do a great deal more work, and make larger bobbins, and all that sort of thing. In a comparatively small yarn-mill, with a capital of one hundred and seventy-five thousand or two hundred thousand dollars, they told me that they are going to make fine yarn, and for the fine process it would cost twenty-two thousand dollars for roving-frames for the last operation, to start with. Now, if it should be found that they can take that roving as coarse as it is before it comes to this last process, and by this excessive draught can draw it down, it is going to make an immense saving. In regard to the matter of weaving, I assume that the yarn I speak of can be made good yarn for weaving on 96 square, or 96 to 100, as the case may be, by adding to the amount of twist. For this slack weaving, they twist the yarn very little: it requires but little of it. By twisting the yarn more, I have no doubt that it would break, not being so strong; and I understand that is the process that is necessary for thick cloth, in a measure. When you have got yarn strong, and it is slack twisted, twist it more, and it will stand the strain of this close weaving. That is my opinion about it. I may be mistaken, but I think that will be found to be the result. I was

talking with a brother of our President a short time ago: and he told me that with different kinds of cotton he had found that in order to weave excessively close goods he had to add to the twist materially, even to make his yarn break at a less number of pounds than it did before he put in the additional twist: and he found it to be necessary in order to make it stand the weaving. I think that is what we have got to do with the yarn I spoke of.

Mr. C. J. Barker. Mr. Draper says by this new process of carding a great saving is to be made in the matter of roving-frames. Now, as I understand the matter, they double on the spinning-frame: hence, with fourteen or sixteen inch draught, I fail to see how he can make a saving on the roving-frame, for that roving could not be any heavier on the new process than on the old process. For instance, if they make four-hank roving and draw eight inches, or put up two, and draw sixteen, I do not see how he is going to make any saving on the roving-frame. I would like to hear that explained.

Mr. Draper. What I refer to is, to have the advantage of double roving at the spinning-frame without reducing it. That is to say, he took his frames as they were, at nine draught, we will say, and put them up to eighteen; and he got the advantage of this double roving at the spinning, and that produces the result. When I can see people take ordinary single roving, short cotton, and run their frames successfully at a hundred and sixteen turns on the front roll, as I saw this running, I may think there is nothing remarkable about it; but I never saw it done anywhere else. The draught is not only sixteen, but it is carried up to twenty-six. Now take single roving, and you draw it thirteen. You do not think of drawing it more than seven. Now, if you draw it thirteen, could you not prepare the roving a good deal cheaper than if you drew it seven?

Mr. Barker. If I run it double on the spinning-frame, I could not.

Mr. Draper. But whether you run it double or single, can you not in either case make roving coarse enough to draw it thirteen, and produce a good-size yarn cheaper than you can seven?

Mr. Barker. I did not understand it that way. I do not see where you gain in carding-machinery. I cannot see that point. I do not understand that Mr. Draper claims he makes

coarse roving and draws single. It is to make fine roving in the card-room which increases the cost of the card for the sake of drawing it double in the spinning-frame.

Mr. DRAPER. I think the rest of the members understand it. If they do not, I will try and explain further.

Mr. BARKER. I do not think any one can blame me for not understanding what Mr. Draper says.

The PRESIDENT. Gentlemen, I believe it is generally admitted that the doubling on the spinning-frame is a very valuable doubling, — the most important doubling made in the mill, as I understand it; but, in order to do it, you must make a very fine roving: therefore, I do not see how the point can be maintained, that by doubling at the spinning-frame there is any saving made in the roving-frame. On the contrary, I should suppose it would require more than the ordinary process.

Mr. DRAPER. Seeing is believing. Go and look at it. The fact is, they have discovered that they can submit it to so much more draught. If you can draw twenty-six, — who ever heard of drawing twenty-six, either single or double? — now, when you find you can see it done, and get good results from it, there is no use in arguing against a fact. When you have the fact, you admit it.

Mr. BARKER. As I understand, there is nothing new, there is no new principle involved in running double roving on spinning-frames. Every one who is familiar with spinning knows this fact, that by running two rovings into one with a medium draught, you will get better yarn. That is nothing new: that has been known for years and years. But the new principle involved in Mr. Draper's is, that we are going to do it cheaper; not only better, but cheaper. Now, I fail to see that point entirely: I think it will cost just as much.

Mr. ATKINSON. Mr. President, to my uninstructed mind it seems the result would be the reverse of what Mr. Draper states, and that you need a less number of spindles rather than a less number of roving-frames.

Mr. DRAPER. You need both.

Mr. ATKINSON. If you take two bobbins, four-hank roving, and put them up to a spinning-frame, and increase your draught enough to compensate for that, and then increase the speed of your spinning-frame, are you not going to make the yarn weaker?

Mr. DRAPER. Mr. Lockwood, as you pretty well know, is not a novice in this matter; and he thinks there is something new about it. He is trying it now. It seems to me to be exceedingly plain, that, if you can draw twenty-six, you can use coarser roving, even if it is double. Suppose you have single roving, that when you draw it seven, you can produce No. 30 yarn from it. What sort of yarn would you produce to draw double twenty-six? Would you not make a yarn very much finer? If you would not, I do not know how to calculate draught.

Mr. ATKINSON. I have seen the yarn Mr. Draper speaks of, and it is a very remarkable result.

Mr. GOULDING. I do not think we understand Mr. Draper. The extraordinary thing is, that tremendous draught on the spinning-frame. There is no change about it, as I understand Mr. Draper. There is no change in the roving. Instead of having thirteen draught, he has twenty-six.

The PRESIDENT. I understand that to be Mr. Draper's point; but, it seems to me, by doubling the roving he used less roving-frames.

Mr. DRAPER. Mr. President, I wish people would take my problem, and not make one of their own. I did state a case where they put in two rovings and doubled the draught. That is plain enough. I did not confine my remarks to that, because I said they had carried the joke further; that, in the room of drawing eighteen, which was double the draught, they had carried it up to twenty-six: and so they can do successfully, and make good yarn. Now, I am not so stupid as to suppose that that roving would make just the same yarn under those conditions; but suppose you have the roving single; drawn seven, which will produce No. 36. You double that roving and draw it fourteen, and it will produce 36 yarn. What sort of yarn will it produce to double the same roving and draw it twenty-six? If you are going to make the same size yarn, and draw it twenty-six, you would have to make the roving coarser. That is plain to me, if it is not to you. Think of it.

Mr. KENT. Mr. President, allow me to improve this opportunity to move that the Board of Government be authorized to lay the usual assessment, not exceeding ten dollars, for the current expenses this year.

The motion was carried.

Mr. GOULDING. Mr. Atkinson has introduced a subject in which we are all interested, the Atlanta Exposition; and before we adjourn I should like to hear from him further on the subject, what the plans and prospects are in relation to going there, and what he expects of the Cotton Manufacturers' Association concerning it.

Mr. BARKER. I think it is proper that some recognition be taken of the paper read before the Association this morning. It is so full of meat, and so full of the good things of a cotton-mill, that I really feel it to be a duty which we owe to Mr. Kilburn, to extend to him a vote of thanks for presenting the matter of carding in so clear and common-sense a view as he has done this morning. Therefore, I move that a vote of thanks be extended to Mr. Kilburn for the able manner in which he has presented this subject.

The motion was carried.

Mr. STILES. I have been informed that the Messrs. Knight of Providence make all their goods on single carding. Is that correct? Can any gentleman inform me?

A MEMBER. I know some mills where they do it. I cannot say as to all of them.

The PRESIDENT. I should say, I think they do generally.

Mr. ATKINSON. Mr. President, I have very little more to add to what I have already said. I will say to you, that in that Exposition building will be brought together more new things than you ever dreamed of. The main point that I have been disappointed in (I know the circumstances were such as to naturally lead to that disappointment) is the lack of interest in New England, as indicated by the lack of adequate subscriptions to the stock. Atlanta led off with fifty thousand dollars the first day, and it has gone up to sixty thousand dollars, or seventy thousand dollars. New York followed, when asked for twenty-five thousand dollars, with over thirty thousand dollars. Philadelphia heartily responded. I do not know what the sum of their subscription is, — about twenty thousand dollars, I think. Cincinnati, Louisville, and many smaller Southern cities, are responding, and are taking a greater interest in sustaining the project than New England or Boston. Boston especially, owing to the men who always lead off (I need not name them, you know who they are) having already a burden upon them, has not yet showed much interest in it; but if you feel

that you can sustain it, — I do not ask it, I do not make any personal appeals, — if you feel you can risk a hundred dollars, with the chance of losing, possibly, fifty dollars of it, in order to show an interest in what our Southern brethren are doing, and to help the manufacturers of cotton as a whole, you will do so. If you do not feel that interest, you will not do it. The matter will be carried through. I anticipate a great success from it. I might ask Mr. Goulding, jun., to make a statement. He has been there, and has seen more of the gin-houses than I have. Many of you know more about it than I do. I can only state one little fact. There is, in South Carolina, one single gin-house where labor is economized, and work is well done; and part of the product is spun in a little mill of twenty-five hundred spindles. It is on an intermittent stream; and when they have but little water they stop their spinning machinery and run the gin-house, for there is more profit in it. I am glad to refer to Mr. Draper, who has made a thousand-dollar subscription to the Exposition.

Mr. DRAPER. Mr. President, I want to say that actions, as a rule, speak louder than words, as to the amount of interest we take in any such thing; and I am pleased to notice that Mr. Pulsifer, proprietor of "The Boston Herald," has subscribed a thousand dollars. He is rather an outsider, so far as cotton manufacturing is concerned. I really think that the Exposition may be the means of doing a good deal of good to the cotton-manufacturing business, and do a great deal of good in cementing the country together, as we want to be cemented together. That is to say, we want to have a fellow-feeling. We do not want to have a solid North and a solid South. We want to have a solid country, one and indivisible; and for the people to meet together in this way, is one of the ways to bring it about.

Mr. ATKINSON. The Secretary asks me whether there has been any action on the part of the Executive Committee to warrant this Association in appointing delegates. I am not a member of the Executive Committee; but I am fully authorized to extend to you an invitation to appoint delegates, or to attend the Exposition in a body. You need not hesitate to take any action, even to the extent of going in a body; and I invite you, on behalf of the Atlanta Exposition, to hold a meeting at Atlanta, at such time as you see fit, and also to appoint a committee who shall be inspectors of the machinery there exhibited, and also to make a formal report.

The PRESIDENT. The Chair would indorse that invitation, and also extend it as a member of the committee. I think it is very important that we should send competent men there, so as to give us the benefit of all new ideas that may be presented there. I hope delegates will be sent.

Mr. CLARK. I move that the Board of Government be authorized to select such delegates, and of such a number as they may think best, to attend that convention.

Mr. GARSED. Before the motion is put, perhaps it will be proper for me to say, as I am a member of the Executive Committee, that I extend, in the name of the Atlanta Exhibition, an invitation to all who choose to go.

Mr. BARKER. The expense of going to Atlanta is considerable, and it seems to me that should be taken into account. I do not suppose the idea is thought of amongst the members, that this Association pays the expenses of anybody to Atlanta. I do not suppose that is contemplated. Hence, it seems to me, if you have a delegate or delegates that shall attend that Convention, that shall go officially from this Association, that it could be much better attended to here to-day than by the Board of Government: for the members are present, and, by making the nominations, it will give the members a chance to decline or accept, as the case may be; and it seems to me that would be the proper way.

Mr. CLARK. It might be difficult, now, to tell who would go; but, no doubt, there are some who would be suitable persons. My motion was, not that the Board of Government be instructed to appoint, but that they be authorized to appoint; and, after finding out who would go, they might designate them as delegates: and, therefore, they would stand in a different relation there to the Association, than what they would if they did not go as delegates. I have no objection to their being pointed out here; but I think the Board of Government, after inquiry, can make a better selection.

Mr. DRAPER. It seems to me, the motion to have it referred to the Board of Government is the proper one to prevail; and I hope it will prevail.

Mr. ATKINSON. Mr. President, I sustain the reference to the Board of Government for several reasons. Those who go as delegates will have to stay longer than those who go merely as observers. There will be a great deal of work to be done by

those who are appointed; and it will be necessary to make a careful selection, which it will be difficult to compass in an open meeting. The Board of Government is competent to do this. It may be a privilege to be on this Board. I assure you, you will have a most cordial and hearty welcome. I have tried it, and have used the plainest of plain speech, and have been welcomed cordially. Whoever goes, however, as the specific delegates of this Association, will have more than a hospitable welcome. I hope the subject of delegates, which ought to have very careful consideration, will be referred to the Board of Government, with full powers.

The motion was then carried.

At this point the Association took a recess.

AFTERNOON SESSION.

The Association was called to order by the President at two o'clock, who stated that the first business to be acted upon would be the withdrawal of several persons who asked for leave to withdraw, their account with the treasury warranting their withdrawal.

Accordingly, the following-named gentlemen were granted leave to withdraw: George M. Goodwin, L. E. Kent, W. H. H. Whiting, John W. Farwell, and William F. Sherman.

The PRESIDENT. The next business in order, laid out in our call for this meeting, is the subject of "Picking." Has any gentleman any thing to say upon this subject?

Mr. ATKINSON. Mr. President, as nobody seems to be ready to speak, I will ask a question, Whether the proper place to pick cotton, in the sense of applying a picker to it, — that is to say, getting the dirt out of the cotton that has been picked from the plant, — whether the true place to treat that is not before it is ginned, rather than after? Theoretically speaking, the cotton in the bale that comes to you is infested with leaf and motes and bits of boll and sand and impalpable dust, and the like. You subject it to various mechanical operations involving the use of beaters that operate twelve hundred to sixteen hundred turns a minute, or in the "preparer," so called, five hundred turns a minute, in order to do what? To get the dust and motes, or immature seed, out of it. By the way, I ought to say that "mote" I found to be a technical term in the South (I did not know it until the other day), applied exclusively to immature seed that passes through the gin. "Specks" they do not call "motes," apparently, as you do. They limit the term "mote" to immature seed. They did not understand what I meant when I talked of bits of leaf and boll, and that sort of thing, as motes. Now, it is the leaf and mote and dust of the yard of the gin-house that are blown into these miserable gin-houses, and infest the cotton, that had been picked from the field in a pretty clean and good condition, with a lot of the trash that has been left behind from the cotton previously passing through that gin; every light breeze carries in a lot of trash that was in the seed-cotton, and deposits it in the lint. Now, your picking is to remove that in part: but all that kind of trash has the same specific gravity as the fibre

itself; and, when you beat it with a rapidly moving beater, and expose it to the draught of the wind of the picker, the light substance that infests the cotton goes along with the fibre of the cotton, and the sand and dust is pretty much all that is left behind; so that, when you have got your cotton into your lap, you have got a very large part of the original leaf and boll with it. Now, I suggested this theoretically some time ago, that, if you could apply some kind of beater, or the equivalent of a beater, — something that would set that fibre in motion while it was still attached to the seed, the seed giving it greater specific gravity than the trash you wanted to detach, — you could put through the seed, with the fibre attached, away ahead of the light stuff, and leave it behind. I did not expect to get that confirmed to the extent I have; but I have received some most remarkable examples of storm-beaten, dirty cotton, infested with so much trash as to be almost without value, that had been put through a machine of that character. I never saw the machine. I do not know how it works, but it is of that character; and that cotton has been converted into ordinary cotton, free from dust and free from sand, — a very good merchantable cotton, worth to-day seven cents a pound. That is one of several of the crude new devices that are being put in operation, and that will, according to my theory, render a less number of beaters necessary after the cotton gets to the factory. Of course, no one may expect to displace the picking machinery, as we know it; but if you can reduce the number of beaters and the number of machines by delivering the cotton to the mill-picker in good condition, I suppose that is a step of progress. There are at least four such machines, one of which is the Ralston machine, described here many years ago, which really is in practical operation, and the product of which has been sent to market in very considerable quantity. The only difficulty about it is, that Ralston has not much capital. He is away down in the border of Texas, and has not any means of introducing his machine. Then, again, its introduction has been retarded by the fact that a very large portion of cotton-growers have not yet been whipped by the schoolmaster of close competition, and rather prefer to have the dust and sand go on with the cotton, than to have it taken out. If you go South, and make an examination in the interior, you will find this: that the shop at the corner of the ways, where the four

ways meet, is frequently operated by a trader, who gets profits of one hundred or two hundred per cent on his goods advanced for the cotton; and it does not make much difference to him whether the bale of cotton he gets is a good bale or a bad bale. He takes so much cotton, and calls it such a price; and a cent a pound to him is not much on that, because he has made a hundred per cent or more on the barter-trade: and in that scattered population, not yet trained up to the economies that we are accustomed to, that is what is happening. They do not yet know enough of the ways of the world to know it pays better to make a good article than a bad one. In point of fact, up to this time it would not have made any difference to the majority of them; but when it comes about that this excess of a million of bales of trash is left on their hands, — as may be the case this year, — the schoolmaster will have come to town. Therefore I suggest that the beginning of picking cotton is to pick it after it is picked from the field, and before it is picked in the factory.

Mr. GARSED related some observations he had made in Georgia in regard to the ginning of cotton, after which the President reminded the Association that the subject before the meeting was that of "Picking."

Mr. GARSED. I should like to have some gentleman in favor of single carding here get up and tell us how he can get an even lap without putting it through a double carding.

Mr. ATKINSON. I made the remark that the object of the card was to straighten the fibres of the cotton. One gentleman had the audacity to come to me in private and say it did not do any thing of the kind; that, after the card straightened the fibre, the doffer snarled it all up again, and that it was really straightened on the drawing-frame. I should like to know if that is really so.

The PRESIDENT. Cannot the gentleman answer the question himself?

Mr. ATKINSON. My function is to ask questions. I have always been under the impression that the function of a cylinder-card was, in part, to straighten the fibres and lay them alongside of each other.

Mr. GARSED. The action of the cards is to clean the fibre by removing the motes and leaf from it: this is accomplished either by the worker and clearer card or flat card; the former

by cylinder and rollers around which the cotton is passed until the fibre is freed or stripped from motes and leaf which, when so stripped off, fall to the floor by their own gravity, or are stripped by hand or fine-roller and comb. Now, that is the function apparently of the roller and clearer cards, so that the fibres are interlaced and crossed in an impenetrable mass, as you may see under the microscope. The flat card is more likely to make the fibre straight than the roller-card: but the function of that card is, that as the wire takes hold of the seed or extraneous matter, it is caught by a flat, and that flat is stripped and taken entirely away, taking a portion of the cotton with it. But the evidence that the card does not straighten and keep the fibres straight is the system of spinning cotton on woollen machinery where there is no drawing-frame. The thread of the same length is nearly one-third larger in diameter, in consequence of the cotton being interlaced as it comes from the card, than the same kind of cotton drawn on the drawing-frame. In other words, it is a different character of cotton yarn, simply because there is no parallelism of the fibres by the drawing-frame. If you take a microscope and look at the fibre, as delivered by the doffer, you will find there is no parallelism about it. If you cut a square yard off, it will be very difficult, indeed for a man to see whether they do go parallel with the doffer, or at right angles with the doffer. I think, not one man in twenty could tell whether it came from one or the other. Now, the railway-head is the first drawing that gradually puts these fibres until they get parallel: and every drawing does precisely that. The superiority of the sewing-thread comes from the combing-machine, which lays the fibre in parallel lines. Then the drawing-frame still continues that parallelism. So that my friend Atkinson was in error partially when he thought that the card function was to make parallel lines of the fibres carded.

Mr. ATKINSON. I accept the "partially," sir. In my uninstructed way, I have observed that difference between the English roller-card and the American card. It appeared to me that there was a pretty important function in converting the fibres into parallel lines to some extent; that is, in putting the fibres into the condition that they would be if put into parallel lines. So, after all, is it not the function of the card either to lay the fibres parallel, or so that they can become parallel?

and is it not the wrong place to look to the card to get the dirt out? Ought not that dirt to be out before the cotton comes there? It has always seemed to me, speaking theoretically, that cleaning cotton on the card is a mistake; that there is a want of skill somewhere; and that, while the object of the card was to take out the noils and partially straighten the fibres, there was room for improvement somewhere about that doffer, whereby it would not be snarled up so much. There is a good chance for Mr. Draper for another patent, but he is not here.

Mr. GARSED. Mr. Atkinson is partially correct. The flat card does lay the cotton more in parallel lines than the roller-card. For this reason the skilled spinner very often uses the flat card for his warp, and the roller-card for his weft, in cotton velvets, cotton flannels, and that class of goods. But the card is to-day the only way we have of cleaning cotton. We put it through the long trough, and the dirt drops by its own gravity out of the cotton; but, after you have done your best, there remains a very great deal of stuff that must be taken out by better means than gravitation. The pieces of seed and trash are so numerous, it is not possible to get them out in any way than by the close-set wire of the card, where, as long as there is any fibre upon it or upon the roller-card, it will be caught and taken along until that fibre is stripped by the cotton-gin; and it would be very largely stripped by the roller-gin in place of the saw-gin. I have never seen in my experience any machine that approached a cotton-card for getting the cotton into condition to be drawn. I think there is no other way known. Probably, if you had a cotton-gin, and placed it in beautiful order, cotton might possibly be combed from that point; although I am sceptical on that. There has been nothing discovered up to the present day except a woman's fingers, with the cotton taken from the field and twisted, to give that motion to elongate it, and, when she sees a thick place, to pull it down. There is no other way of doing that except a woman's fingers. Now, let us try, in the first place, to improve the cotton in preparation; but we cannot dispense with the card and the drawing-frame.

Mr. ATKINSON. No, we cannot dispense with the card undoubtedly; but you use a great deal more carding-surface than you would need if that dirt had not been left in, and glued in by the addition of water. In order to correct the original faults that ought not to exist, you pick your cotton twice as much as

it ought to be before it comes to be carded; and then, when you have got through, you have weakened its strength about twenty per cent. It also touches the question of compression. That is, when you put some woody fibre, that contains oil and gum, and cotton together, and squeeze them in a powerful press, you have fastened the trash to that fibre in a way that it is pretty hard to get off. You will have to work to get it off, and the more you work it the more you will injure the cotton. So I say cotton well ginned is half-carded and almost wholly picked.

The PRESIDENT. I see several pickermen present. I hope some of them will have courage to impart some information on this subject.

Mr. ALFRED CLARKE. Mr. President and gentlemen, I think the difficulty in talking about picking is to get any thing like an accurate or satisfactory test. That is a test that can be rarely given except by the man that sees the cotton before it goes into the picker, and the man that is capable of judging of the quality of the work after it leaves the picker. As Mr. Garsed remarked, the great trouble that manufacturers and picker-makers have to contend with is the limited knowledge of the users of cotton, of the first preparation of the cotton, so that picker manufacturers often have to take the blame for that which they are not guilty of. For instance, the cotton that has been badly ginned is full of kinks and curls, so that the best picker we have to-day will only partially take that out. And, when the cotton is fairly opened up from the consolidated masses in which it arrives in the bale, it then only shows the defects of bad ginning, which the picker manufacturer gets the credit of as being bad picking. In the second place, picking and cotton-pickers is a subject which engages the least attention of agents in general. There is not one agent in twenty that pays one visit to his picker-room where he will pay twenty visits to his card-room or spinning-room. Why? Because the picker-room, in the majority of cases, is the worst part of the building and the least attended to: it is draughty; it is dusty (because of its imperfect construction); there are a number of fans revolving, fifteen hundred, seventeen hundred, or two thousand revolutions a minute, exhausting immense quantities of air, removing thousands of cubic feet; and you won't find, at times, an opening to a picker-room sufficient

to supply one fan where you will find thirty fans working. Not only that, the outlets from the dust-pipes of the pickers are, in great measure, insufficient, and, like the crippled exhaust of a steam-engine, instead of getting a full current of air here, which will carry the dirt, refuse, motes, and sand with it, it has a back action which blows right back into the picker, and you have a swirl instead of a current. And, as I say, the difficulty in getting any one to speak on picking is because reports to us are, in a great measure, so contradictory, and the machine, in nine cases out of ten, never had a fair chance; and the result is, instead of enlightenment we have only mystification. Now, it does not always depend on the make of a machine. The most important part of picking is the place in which the picker works, and a great many people forget that. They think, if a picker-room is light, if it is protected from the weather, that is sufficient; and they never look at the outside circumstances, upon which the picker depends so much. Now, I think if manufacturers in general were to pay more attention to their picking-rooms, they would find that the machines which they have would be capable of doing at least twenty-five per cent better work, I might say fifty per cent better work, than they are doing at the present time. With regard to the various modes of picking, there are so many I could not tell you all of them. There is the rigid blade, that has been spoken of, which is used in picking cotton. That, I believe, of late — the last year or two — has been done away with to a considerable extent; and cotton is prepared in a machine by another apparatus that greatly lessens the severity of the rigid blade on cotton. That is, the cotton is opened in a gradual manner from the bale until it gets to the beater, which takes away a great deal of the severity of the beater. Further, there is also combined with a beater, especially in the finisher-picker, a method of treating cotton that ought to be called a magnified card-cylinder. That is what we term the "Scratcher;" and that represents the first part of the carding. It is really one system of carding on a very coarse scale, and that is the last operation previous to going to the card. We term it the "Scratcher cylinder." The teeth are probably one-half inch apart, with a projection three-eighths of an inch from the cylinder. The teeth run in close proximity to the feed-roll, from three-sixteenths to one-eighth of an inch. The cotton undergoes one system of

believe, by that process alone more of the fiber and leaf and objectionable parts of the cotton. I should like an expression of some other on this matter. The draught is taken the picker: it is one part of the finisher-picker. two sections would contain one beater and scratcher being in the second section of the

should think we ought to pick something

regard to pickers generally, I can indorse far as draughts are concerned. And ught to be said here, that all manufac- — well, perhaps I ought not to include manufacturers expect too much from their making a great mistake in putting ker. I noticed particularly, the last the mills that were running closest, cheapest, that they were slowing rates. They were taking laps to a putting three opener-laps up to it, and with an evener on the second, and I must say I never saw better laps in The result was, the carding is a great more weight through their cards saw them: and I attribute it to the picker-room. The attempt picker is dangerous. There is no picking is small, and the extra the weight: and it will be found less will be necessary to do the about picking, and that is, stance. I saw some mills in g it six hundred feet. They keep their cotton in a safe tube, taking the dirt out proper. And that was st in any direction, into an opener. That at the rate of twenty-five thousand pounds a week machine. That is the greatest improvement in openers I have seen. Some of them are now

at work in this country; and I think it is a step in the right direction, to keep the cotton in a safe place, and have nothing in the picking-room but laps. In mills that have these machines, I think the insurance is one-half of that where they keep the cotton in a loose state.

Mr. WEST. Mr. President, I suppose, from what I have heard here to-day, the time will come before long when we shall need no pickers. After the cotton has been improved, in the way they talk of its being improved, — before we get it, — we shall have no need of these rigid blades, and such kind of contrivances as have been mentioned here. But there seems to be a great objection to the rigid blade of a picker-beater. The question is, whether there is any better method of taking out the heavy substance from cotton than a rigid blade. This must be done by a blow, imparted in order to get this heavy substance out; and what better method is there than a rigid blade? It looks to me as though the trouble is more from the fact of the feed-rollers being placed too closely to the blade, than from any objection to the blade itself. Of course, we can set the blade of a beater so close to the feed-rolls that it will cut the staple all off; or we can place it off at the proper distance, which will enable it to knock out a portion of the dirt in the operation, and then through a series of beaters get out most of the objectionable matter. I have heard a great deal of objection made to the rigid blade of the beater compared with some other contrivances that have been placed on the market, but have never been able to see the force of the objection. The principal trouble is in the adjusting of the machine. You can strike, certainly, a heavier blow with a hammer than you can with a long bean-pole; and the same principle exists in a beater compared with some of these other contrivances. Is not the trouble with the adjusting of the rigid blade of the beater rather than with the beater itself?

Mr. BARKER. Mr. President, it seems to me that Mr. Atkinson's former remarks in regard to preparing the cotton, picking it, before we get it, have a greater bearing on the future of picking cotton than any machine that we now have in use. We have at our mill the English machine, the Kitson machine, and a Whitehead and Atherton machine. They are all good machines; but it seems to me the machine-builders have a little something at stake here. It is well known amongst all the

agents of cotton-mills, that picker-builders will come to you to sell you a picker, and they will claim that their machine will do all the way from twenty-five to fifty per cent more than it can possibly do. Now, in order to meet the requirements, and to meet the demands of the machine-builder, we overdo the thing. We try to meet the demands of the machine-builder: hence we hear them say that the agents do not visit the picker. They do not know what they are doing, really. They have got their machine put in; but they haven't draught enough, they haven't outlet enough, and the whole thing is generally demoralized.

Now, sir, I apprehend, that the machine-builders are somewhat at fault in this matter. They claim nearly double what their machines will do. We try to do it, and fail. And really, looking at the cotton as we get it from the South, I do not wonder much that we do fail. Take cotton that is picked as we have heard it stated here to-day, and put into rude sheds, or out of doors oftener than in sheds. For I have seen cotton ginned in the field without any house over it at all, and carried to a compressing machine, with a compressor of two hundred and fifty tons put to it, compressing a bale that stood as high as my head, nearly to the density of white oak, or at least down to eight inches. And they send that bale to our mill, and ask us to open it with the machine that we have to do with. Why, sir, it is next to impossible to do it, and accomplish anywhere near what the machine-builders claim their machine will do. Now, it seems to me that there is to be a cure for all this; and I am quite confident that this Exposition at Atlanta is going to make a revolution in that direction. A large proportion of the New England cotton manufacturers will go down there next fall; and, when they come to see the crude ways in which cotton is raised and picked and compressed, they will come home and wonder that they have ever been able to do any thing with it. And I do honestly think that this Exposition is going to do a great thing for the cotton manufacturers of New England, for the cotton-growers will get their eyes open. They will become satisfied it is better to send cotton up here, than to send up Southern soil. I am sure, that, when they once know the difficulties and trouble we labor under, they will work for their own interest. They want to make a profit on raising their cotton, as much as we want to make a profit in manufacturing it: and, as a rule, the planters are shrewd, care-

ful men; but they have been plodding along in the ruts of their fathers for a hundred years, and they pick and gin their cotton exactly as they did fifty years ago. There is no improvement. Now, what would happen to us, to carry us back fifty or seventy-five years, and ask us to compete with the world, in manufacturing cotton goods? Certainly we could not do it. And right there, it seems to me, is the place for the agents of New England cotton-mills to take hold and lift in this matter, urging on by every possible means the better cultivation, the better picking and ginning, of cotton in the Southern States, so that it shall be brought to us in a better manner, better picked, and with less compression. I suppose that the matter of compression is to save freight. Well, we save probably half a cent a pound in freight. I am not certain about that, but maybe we save half a cent a pound. But I claim that that manner of compressing cotton damages the cotton more than ten per cent. I do not believe it is in the power of machinery to take that cotton, after being compressed down to the density that they press it, and open it, and make a smooth, clean fibre. Hence I believe that a large proportion of the unevenness in our cotton is caused by that very thing.

Mr. CLARKE. "How much cotton do you put through your machines?" I have been asked this question in nearly all cases; and I invariably reply, "Just as much as you want me to." Now, every man knows that the less you put through, the better you are going to pick it; but if it is absolutely necessary you should put a certain quantity through, and you are willing to do the rest of the picking in your card-room, that is your business, not mine. In the next place, there is an incident that occurs to my mind well worth thinking of amongst cotton manufacturers. I was interested in testing an evener the other day, — a cotton-evener. Everybody is trying to get even laps. One man will tell you there is no way of getting even laps save by weighing it. Then the question comes, In what way do you want to even your lap? Do you want to even the lap by weight or by bulk? If you want it by weight, weigh your cotton. If you want it by bulk, do it by mechanical methods. I was shown a table giving the result of an evener for about forty or fifty laps. The variation was a little more than half a pound to the lap, when, all at once, the variation was from two to three pounds, — went up from forty to

forty-three pounds. I said, — What is the cause of this variation? The reply was, — Oh! you see we are rather crippled for room at our packet-house. We cannot get more than one or two bales at a time, and they happened to be put up last. That accounts for the variation in weight. Now, this man was really getting even here in both cases. Probably the forty-three or forty-four pound lap in bulk is not more than the forty-pound lap; but it demonstrated as ever lap in bulk from the single fact that one lap of cotton had more moisture in it than the other, and consequently the lap weighed heavier, whereas the bulk of the cotton was exactly the same.

The President. Gentlemen, as evidence of the state of feeling existing at the South, perhaps it will not be amiss for me to read a letter which I have recently received from the President of the Mississippi Valley Cotton-Planters' Association, dated April 11.

VICKSBURG, Miss., April 11, 1881.

To JOHN KILBURN,

President New England Manufacturers' Association, Lowell, Mass.

Dear Sir, — Looking to the extension of our Association throughout the cotton States, and its better organization, and in order further to benefit our class and the country at large by a conference of planters and manufacturers from all sections of our country, believing that the South is now on the eve of the greatest transition period of improvement ever known in her history, I have been directed by our Association to invite delegates from all the cotton States, as well as from the principal manufactories of this country and England, to meet with us at our Annual Convention in Memphis, Tenn., on the 25th of May prox. As President of the New England Manufacturers' Association, you are cordially invited to attend the Convention.

We also beg to enclose you some blank invitations, which we would be more than gratified if you will fill with the names of representatives interested in cotton and manufactures who *will* attend.

In its immediate bearing on the agricultural and internal development of our country, and as a fitting prelude to the great International Cotton Exposition to be held this autumn at Atlanta, the coming Convention cannot fail to be of immense value, not only in awaking our people with new energy and hope to more economic methods of farming and the importance of manufactures, but in directing capital to the unbounded resources the South now offers for investment.

Your co-operation is earnestly desired; and we doubt not a good representation of the manufacturers from your State will be of great mutual advantage.

Awaiting your reply, we beg to remain,

Sincerely yours,

F. C. MOREHEAD,

President Mississippi Valley Cotton-Planters' Association.

Mr. BARKER. I would make a motion that the invitation from the Cotton-Planters' Association be referred to the Board of Government, with instructions to act in the matter as they see fit.

The PRESIDENT. This being a personal matter, I have replied to it. There was no meeting of the Board of Government at the time. I read the letter to show the state of feeling in the South. I have also received another letter from the same Association, inviting me to come there and address the Convention; but, not being a speech-maker, I did not think it best to accept.

Mr. BARKER. Mr. President, as brother Atkinson is here, I will tell this little story for his benefit. I heard a gentleman make a speech in regard to the Clement attachment. Considerable discussion arose to know what it was, as I had never seen one; and I wished to hear more about it. He claimed that the Clement attachment, put on to a common card, would produce from five hundred to seven hundred pounds a day; that it was a poor man's cotton-mill, and everybody could have a cotton-mill by its use: in fact, cotton was all going to be worked up on the plantation, and we up North would have to turn to the raising of ice. Well, of course, being a manufacturer, and knowing something about the quantity you can put through each card, I raised the question. "Well," he says, "you got that from Ed Atkinson. His idea is, that you have a cotton-mill on one side of a stream, a paper-mill on the other, and a —— big banker pretty near by."

Mr. ATKINSON. The Clement attachment is nothing more than a little saw-gin connected to a card.

Mr. BARKER. I was really under the impression that they could do a great deal more than they do. They take cotton from the seed. It is not pressed. It is delivered to the card free.

Mr. ATKINSON. In regard to compression, that is really a very open question. There are two modes of compression. One is, to take the five-hundred-pound bale of cotton, after it has been filled up, and put it into one of these awful presses, and squeeze it down to eight inches. If there is any difference in the comparative density of that bale, one part as compared to another, you can see that there is a tremendous strain, a differential strain on different parts of that bale, as the pres-

sure comes upon it; and there must be more or less injury by that compression: but I have seen small bales of cotton put in a little hay-press, where it is packed up in small quantities at each stroke of the press. That brings out a bale that is much more dense than you can get from this big compressor. The bale that is put through the ordinary press, with two hundred tons' pressure, comes out at an average of about twenty-five pounds to the cubic foot, as I am informed. It has been pressed to a greater density than that; but after the hoops are put on, and the bale is taken out, it bulges out between the hoops, as you all know, and the average density is about twenty-five pounds to the cubic foot. A bale pressed in the Dedrick hay-press is about forty pounds per cubic foot. The Cotton Economy Company of New Haven use a press of that kind. Some bales were sent to Massachusetts; and I believe the reports were, that there was very little, if any, difference, as compared with the ordinary compressed cotton, although you could not draw a sample from it, nor could you get a knife into it. It was of the density of oak-wood. Now the question comes, whether cotton compressed in that manner, by successive operations upon each particular lap, will be injured, or whether you can compress the fibre so as to harden it. That is an open question, and a very important one. Now, in regard to the fact of compression saving freight: Undoubtedly it is done in order to save freight, and it will be necessary to save freight by compression in sending cotton to Great Britain; but the saving of freight between the North and South is being compassed in an entirely different method. I have got upon a subject that I will have to pull myself in on; but suffice it to say this, that in the last ten years the reduction in the charge for carrying merchandise, grain, and meat between the East and West, has been compassed to that extent that the difference in the rates upon the New York Central Railroad from 1870 to 1879, as compared with 1866 to 1869, measured in gold, is $120,000,000. That is to say, if for the last ten years the rates of the previous four years reduced to gold had been applied to that road, the country would have paid $120,000,000 more than it has for the movement of merchandise from the East and West. That road has received more than one-twentieth part of the freight-money paid in the United States. Multiply $120,000,000 by 20, and you have a saving

in railway traffic in ten years of $2,400,000,000 in gold coin! This proves too much. The rates of traffic have not been reduced on other roads in such a degree as they have on that particular line, on all the great through routes from East to West. There has been no such reduction on the roads from the North to the South; and you are paying to-day on your cotton traffic, on your Southern and South-Western traffic, a rate of freight that is substantially equal to that which was paid on the Western freight more than ten years ago. Now, this is really an enormous question, as affecting the manufacturing industry of New England. Without that saving in freight on the East and West lines, the crops could not have been moved. The portion of the grain-crop of the West which was exported in 1880 was 8,000,000 tons. The difference between the rate that was charged, in gold, and the gold-rate prior to 1870, from 1866 to 1869 inclusive, amounted to $26,500,000, — more than twenty-six and one-half per cent of the entire value of grain exported. If that reduction had not been made, the crop would not have been raised, because it could not have been moved. Now, when the consolidation of lines that led to the change in the Western traffic, beginning in 1869, shall have been applied to the Southern and South-Western traffic, and there shall be a combination of lines to Louisville and Nashville, there will come a reduction in the rates for bringing cotton from the South to the North, like what has occurred between the East and West. Now, what is the bearing of this? If you eliminate distance between the cotton-field and the cotton-mill, then the cotton-mill may stay where the conditions of life, the climatic conditions, and the conditions of society are most fit for it; and the cotton may be raised and prepared with profit to that section where the climatic conditions, and conditions of life, are most fit for that. The distance being wiped out, the two are brought near together, as the great industrial forces that are now working throughout this land, and are bringing every section together, so that there shall no longer be either North or South, or East or West.

But you cannot wipe out three thousand miles of ocean traffic for that purpose. You cannot do away with the necessity of pressing cotton-bales. You cannot reduce the rates much below the charge that has been made for the last fifteen years: you cannot much diminish the average charge that has been

made for moving cotton from the South to Great Britain. You have been seven-tenths of a cent per pound nearer the cotton-fields. How much higher wages can you pay in your mill, and yet lay all your goods down at a distant port on equal terms with other parts of the world, because you have that advantage of proximity to the cotton-field greater than you ever enjoyed before? You will have in the next ten years a proximity of New England to the cotton-field perhaps equal to a two-thirds reduction of the previous charge. I say that these are great questions; they are far-reaching questions; they are questions that interest not only the cotton-manufacturer and cotton-spinner, but every citizen in New England, and in this broad land. The saving on the whole railroad service of the United States, as compared with rates previously charged, that can be proved to a demonstration, and cannot be gainsaid, since the 1st of January, 1870, is more than the whole sum of the national taxes that have been assessed by the National Government during that whole period. I did not mean to go into this matter, but somebody led me into it.

It may be inferred, from remarks which have been made, that, in handling the cotton between the field and the manufactory, it is often imperfectly cleansed, and unnecessarily injured and soiled. It is said that a good gin, in good order and properly tended, leaves the fibre in condition fit for the breaker-card, and that, with good ginning, both the opening and the picking may be dispensed with; but that a radically defective gin, a good gin out of order, or one badly tended, may injure the fibre, imperfectly remove ordinary dirt, or powder and mix the leaf with the fibre. Again, it is said, that while in store the fibre often becomes injured by wetting, or contaminated with sand and dirt, which must be removed at the manufactory. It is still further said that the fibres become matted and entangled in being compressed in baling, and that the damage to the fibre in opening and picking is far greater than it would be if it were not for the matting and entanglement due to the process of compression.

Supposing these things to be so, is there any doubt, that, if the distance from the field to the manufactory could be sufficiently reduced, the picked cotton would be prepared for the card more perfectly, with less destruction of the fibre, and at less cost, in the manufactory where it is to be carded than else-

where? Could the increased cost of good ginning approximate to that of the baling, opening, and picking processes combined? Should we not deliver stronger fibre to the card? Would it not pay for those manufacturers who are so near to the fields that the additional freightage would be small, to do their own ginning? Would not the use of light cars, designed expressly for the purpose, make it practicable to transport to greater distances either the unginned cotton or the ginned or carded cotton uncompressed? Probably *exported* cotton must continue to be baled. But I ask, to raise the question, and for information, *would it pay* to transport cotton *uncompressed* to our Northern manufactories?

Mr. ATKINSON. The oil and dust would still be in it.

Mr. WHITAKER. Then that would be impossible. The question of transporting it without compression is only a question of the size of the cars. Could it not be carried in pneumatic tubes, as oil has been carried? I think cotton might be possibly moved from point to point in that way.

Mr. ATKINSON. I would state, as a matter of information, that a skilful manufacturer has undertaken at my request, during the next season and during the Exposition, to take a particular parcel of cotton, grown upon a particular field, and gin part of it himself, and work it directly from the gin into yarn of a given number. He will then take another parcel of the same lot, and press it in the ordinary press, without compression, and set that aside under the usual conditions for a period such as he may have time to avail himself of. He will then open that, and convert it into the same number of yarn. He will also have prepared another third part of the same parcel, which he will subject to the utmost compression that he can obtain in Charlotteville, N.C., where there is a heavy compress. He will then open and work that into the same number of yarn. I think he is competent to keep the record of the waste, as far as it can be kept; and he will have those samples of yarn as a standard, which may be the first experiment in this direction. That is one of the things I have endeavored to start in a small way, in order that these various points may be determined. I have also written several Southern men to have them observe and compare their experience in working cotton from their own gin without compression of any kind, and their reports will be at your service after a certain time.

Mr. GARSED. I would like to say that Mr. —— is present, and would be glad to confer with the members of the Association in relation to the Atlanta Exposition.

Mr. ATKINSON. If this subject is exhausted, I would say, for the information of members who may not be entirely sick of the subject, that experiments in lubricating have been continued under Mr. Woodbury's charge the past year, and are now ended. I ask leave to put into the hands of the Board of Government for them to print, if they see fit, the further results of those experiments upon our machine. They indicate and prove a change in the manufacture of the very best lubricating oils in a measure that the makers stated to be impracticable at the time we started upon this quest. They have lowered the point of evaporation, and made a much less volatile oil. They have raised the fire test; and they have reduced the co-efficient of friction under the conditions of a spindle by about thirty-five per cent, as compared with the best result that we could get from the best oil that was on the market two years ago. Of course the tables are too long to be referred to; but they can be printed, if the Board see fit.[1]

Mr. BARKER. I move that the tables referred to by Mr. Atkinson be referred to the Board of Government for printing, if they think best.

The motion was carried, and the meeting then adjourned.

[1] These tables will be reserved to be published later, when they can be presented in a more complete form. E. A.

[No. 31.]

N.E. COTTON MANUFACTURERS' ASS

PROCEEDINGS

OF THE

SEMI-ANNUAL MEETI

HELD AT BOSTON

OCT. 26, AND, BY ADJOURNMENT, NOV. 30, 1881.

BOSTON:
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1882.

CALL FOR MEETING.

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION,
BOSTON, Oct. 1, 1881.

DEAR SIR, — The stated Semi-Annual Meeting of the Association will be held at the Massachusetts Institute of Technology, Boylston Street, Boston, on Wednesday, Oct. 26, and, by adjournment, on Wednesday, Nov. 30, 1881, at ten o'clock A.M., with an afternoon session commencing at two o'clock.

The Board of Government propose for renewed discussion the subject of CARDING, with especial reference to the use or non-use of drawing, and particularly request a full and free interchange of views upon this topic.

By invitation of the Board, NATHANIEL HILL, Esq., of Lowell, Mass., will present a paper upon METHODS OF TRANSMITTING POWER BY BELTS, WHEN THE AXES OF THE CONNECTED SHAFTS ARE NOT PARALLEL.

The subject of the COMPARATIVE MERITS OF RING AND MULE SPINNING will also be presented; and any member who has information to give on the subject is cordially urged to impart it at the meeting.

The delegates of the Association to the Cotton Exposition at Atlanta, Ga., will be present, and report fully their observations and conclusions.

An early and full attendance is invited.

By vote of the Board of Government.

AMBROSE EASTMAN, *Secretary.*

NOTE. — The Board of Government, in view of the fact that very many members of the Association will be absent at Atlanta at the time for the semi-annual meeting, have voted that it is expedient to hold the meeting at a later date the present year; which will accommodate such absentees, and will permit the report of its delegates.

Therefore, the meeting of Oct. 26 will be purely formal, and be immediately adjourned to Nov. 30 next.

A. E, *Secy.*

PROCEEDINGS.

BOSTON, WEDNESDAY, NOV. 30, 1881.

THE adjourned semi-annual meeting of the New England Cotton Manufacturers' Association was held at the Massachusetts Institute of Technology, Nov. 30, 1881, at 10 o'clock A.M. About one hundred and fifty members were present.

The President, Mr. JOHN KILBURN, occupied the chair, and called the meeting to order by requesting the Secretary to read the call for the meeting.

(The call was read.)

The SECRETARY. In accordance with the notice, a meeting of the Association was held Oct. 26, and was immediately adjourned to the present time and place.

The PRESIDENT. If no objection is made, the reading of the records of the last meeting will be omitted. The next business will be the consideration of the admission of new members recommended by the Board of Government.

The SECRETARY then read the by-law governing the admission of members, and stated that the gentlemen whose names were about to be presented, were, by vote of the Board of Government, recommended for membership in the Association.

The following-named gentlemen were then admitted by vote to membership in the Association: —

O. S. BROWN	*Salmon Falls, N.H.*
JOSEPH DRONSFIELD	*Providence, R.I.*
PHILIP H. FOWLER	*Gloucester, N.J.*
ROLAND R. KELLEY	*North Adams, Mass.*
IRA F. LAURY	*Taunton, Mass.*
THOMAS L. LIVERMORE	*Manchester, N.H.*
ANDREW J. WOODMAN	*Harrisburg, Penn.*

The SECRETARY then stated that he had received notice from the following-named gentlemen of their wish to withdraw

from the Association on account of their having left the cotton-manufacturing business, and stated that all dues from them had been paid. By vote they were permitted to withdraw, — Messrs. Phinehas Adams, William C. Avery, John A. Bennett, and Edward W. Codman.

Mr. ATKINSON. I offered the motion which was adopted last year in regard to the admission of members. It was a little imperfect in some of its details, and I propose to offer an addition.

The article will then stand as follows: —

ART. 8. All nominations for membership shall be made in writing, at least one week before the date of any regular meeting, and shall be considered by the Board of Government, and reported to the meeting, favorably or adversely, for the action of the Association: provided, that, in case the Board shall decide to report adversely upon any nomination, the member who shall have made it shall be informed of the intention so to report, in order that he may have an opportunity to withdraw the name. Upon such report, new members may be admitted, if they obtain a majority of votes of the members present, upon signing the By-Laws, and paying an admission-fee of ten dollars, and an annual assessment not exceeding ten dollars. Any member may withdraw from the Association at any regular meeting, upon payment of all arrearages, first giving notice of his intention so to do to the Secretary; and any member may be expelled *for cause* at any regular meeting, two-thirds of the members present voting therefor.

These are matters of form, to maintain the organization. They do not touch the substance of the change adopted at the last meeting.

The PRESIDENT. Gentlemen, the next business in order is the subject of CARDING, which has been continued by vote to the present time. If any one has any thing to offer on the subject, we shall be glad to hear from him. I will say, for the information of the Association, that, at the time the subject was continued, it was expected that a member of the Association would prepare and present a paper on the subject of carding; but sickness has prevented him from doing so: consequently the subject is presented in this informal manner.

Mr. GARSED. I have the honor to present to the Association a bale of cotton grown in the State of Pennsylvania, with the compliments of the grower. It is expected a very much larger crop than that will be grown next year on three hundred acres.

Mr. Garsed then laid on the President's table a miniature bale of cotton from Fallon Brothers, cotton brokers, Philadelphia.

No one offering to speak on the subject of carding, the PRESIDENT said, —

If nothing is to be said on the subject of carding, and Mr. Hill not being ready to present his paper upon "Methods of Transmitting Power by Belts," the next subject will be the "Comparative Merits of Ring and Mule Spinning." Has any one any thing to offer on the subject of ring and mule spinning? It would be a little strange if our friend Draper did not have any thing to say on that subject.

Mr. GEORGE DRAPER. Mr. President, if I were sure that the gentlemen present would be glad to hear me say something on the subject, I would not object, I am sure; but I would not care to push myself forward in the matter.

The matter of ring-spinning compared with mule-spinning was brought up in this Association a good many years ago; and I recollect that the gentleman who is now presiding, Mr. Kilburn, took part in that discussion, and spoke of the change that had been made at Salem, and the result of it: but what was said at that time applied to the spinning of that day, which was the ring-frame with what is termed the common taper spindle. That spindle prevailed up to 1871, and was probably used on three-fourths or more of all the warp-spinning there was then in the country, aside from mule-spinning at Fall River. It was maintained that they could make yarn cheaper on mules than on frames; i.e., No. 28 warp-yarn; on account of its consuming less power, and on account of less cost of the machinery, and so forth. They were not willing to admit that their mule-yarn would not weave as well for warp as the warp-yarn. That must have been some twelve or fourteen years ago. I know it was stated that the change that had been made in the Naumkeag Mill, where they had built new mills adapted to frame-spinning for all their warp, was very beneficial, also at the Hill Mills at Lewiston and other places; and the parties who were connected with it testified to the beneficial results of having done so. But at Fall River, up to 1871 or 1872, with one or two exceptions, they spun all their 28 warp-yarn on mules. Now, as about 28 warp-yarn forms the warp of all the print goods which are made in the country, and the print goods are about half of all the goods that are made in the country, it not only embraces them, but it also embraces a very large amount of the finer sheetings, or medium sheetings, of the country; so

that in reality the question what you shall spin No. 28 warp-yarn on is the question that concerns the largest amount of warp-spinning in this country, by far. Then, about 1872, there was introduced, as you all know as well as I do, the Sawyer spindle; which reduced the amount of power that was consumed in driving the warp-frame, per pound of yarn, nearly or quite one-half, compared with the common spindle. We commenced to introduce them into Fall River. They were put into the King Philip Mill on somewhat finer yarn, and they were put very soon into the Pocasset and a few more mills. Now, so far as I know, the question of spinning 28 warp-yarn on mules has been fairly settled by the experience of manufacturers. I do not think that there has been a single mill in Fall River that has bought mules to spin warp-yarn on, since that day. There have been a good many mills there where they have built a second mill, and they have bought frames for all the warp of both mills, and are using the mules they had for the other yarn. I will instance the Wampanoag Mills and the Union Mills as examples.

Another thing that was claimed by the Fall River people at that time as important was, that the yarn made on the mule produced a better article for printing; that is to say, that printers would prefer it if the warp was made on mules. It made a class of goods that the printers would give the preference to; but their attention was called at that time to the fact that every single printing establishment in this country where they made their own goods, I think without exception, made their own warp with the frames. The warp was made on ring-frames with the single exception of the Merrimack Mills; and at the Merrimack they made both the warp and the filling on throstle-frames, which are understood to make a harder and rounder thread, with less fibre on it, than in the ring-frame: so that the question is pretty well settled by the fact that all the new mills that make print cloths make their warp on ring-frames. I might also add, in connection with what I have been saying, that the ring-frame is being rapidly introduced into England, after all the opposition that has been made in regard to it, and against their fixed habits; and the call for the ring-spindle there, I am told, is enormous.

Now, then, we have another question which is going to extend the use of the ring-frame, — the question of filling. Take

the No. 36 filling. Now, as there is by far the largest quantity made of No. 28 warp, of any number of warp-yarn in the country, so No. 36 filling or thereabouts embraces by far the largest amount of filling-yarn there is made in this country. I refer to that which gives the most employment to the most looms; but at the present time, and for two years past, we have been demonstrating the fact, that filling-yarn can be spun and woven cheaper and with far less waste spun on a bobbin on a filling-frame than it can on a mule. The impression has been made so far, that at the present time in the Hamilton Mill, which is being erected in Lowell with fifty thousand spindles, all the warp and filling is to be made on ring-frames. There is no mule about it. I would also call attention to the fact that the Hamilton Woollen Company, who have put up a mill with about sixteen hundred looms, and have something over half of them started, are to have all the warp and all the filling made on ring-frames. I have heard, since I have been here this morning, a report that they are exceedingly well pleased with it. I have also to report, that at another mill where they have been making a fine class of goods, after a very thorough trial they are adopting a lot of this ring frame-filling. There is also on my left a gentleman from Brunswick, Me. [Mr. Benjamin Greene], who has been a successful manufacturer for very many years; and last year at his mill they made quite a large addition, calling for several hundred looms: and after a trial on the fine sheetings, — their Cabot sheetings, — they have put in some twenty-eight frames, I think, and have been running them some few months. So far as I have heard, — I have not asked Mr. Greene about it this morning, — they are giving excellent satisfaction.

Perhaps I ought to say in connection with this, although I want you to understand that it is one of my inventions [laughter], it has cost me more than twenty thousand dollars so far in trying to give it away. [Renewed laughter.] I have never asked a cent for it. I have no doubt twenty thousand dollars would be below the mark of what I have spent, but I know I am right: and I know that the thing is going to be adopted, and has got to be adopted; for people are going to spin filling on frames, especially the finer numbers; that is, what is known as the *evener*, which gives a variable speed to the front roll to strengthen the yarn. When you spin on the barrel of a bobbin,

at that point it adds a small portion of the strength taken from it when you are spinning on the outside. The effect of it is to strengthen the yarn; making it spin better and making it weave better. The same kind of frame that Mr. Greene tried at Brunswick, and that converted him to the practice of spinning his filling on frames, was sent to the Cocheco Company at Dover; and the agent wrote me that it ran better than any ring-frame he ever had in his mill: but they did not adopt it, he said, for this reason, that their goods had always borne such a reputation in the market, the selling-house was afraid to have the change made, on account of the character of the goods; and therefore they did not adopt the frame. That same frame is now running in the Pacific Mills at Lawrence. I asked the agent about it this morning, and I got an excellent report from it; and he has had an experience of two or three years running two or three thousand spindles on No. 36 filling at the Globe Mills at Woonsocket. There he was satisfied with the nature of the work. It was an entire success.

Now, gentlemen, I do not want any of you to be deceived about the fact that I expect to make money by the introduction of that invention; but I have an interest beyond that. I want to see this country get so that it can produce cheaper than any other country on the face of the earth; and I am willing to work with others to that end, and I expect to get a living out of it. [Applause.]

In response to an inquiry whether Mr. Greene's goods were bleached, or not, Mr. Draper said he did not know. Then added, One word further: I feel as though it were a matter of interest. Without regard to the character of print goods, or without regard to brown goods, I want to say one thing, that Messrs. B. B. & R. Knight of Providence, R.I., very successful manufacturers, as you all know, make the goods called the "Fruit of the Loom," and have a bleachery of their own. Mr. B. B. Knight told me that he and his brother Robert, who grew up in the mill, had some cloth made at their Pontiac Mill, with the filling spun on these frames and also on the mules, and that they had four pieces of each kind marked: and he said they were brought in, and he and his brother picked out four pieces that they both agreed were the best-looking goods; and every one of them proved to be the ones that had been spun on the frame. The goods had not so matted an appearance. The thread

seemed to be rounder. The father of the president of this Association had a frame, and ran it for a while, — one of the first filling-frames that we tried, on the Lonsdale goods; and he told me that every man that examined it, from the loom to the selling-house, pronounced that cloth superior in its appearance to that that was made with mules.

The PRESIDENT. Do you know why it was not adopted?

Mr. DRAPER. I think there were two reasons why it was not adopted. I have not any doubt in my mind, that with your father's knowledge on the subject, if he had kept along, it would have been adopted; but Mr. Pratt coming in when the thing was on trial, and not having had any experience with it himself, there was some difficulty about that time about wetting the bobbins; and we did not have all the experience then that we have had since, and he felt it was too much of a responsibility for him to take just then; but he is considering the matter favorably; and I have not any doubt but they will come in there, and everywhere else for that matter. [Laughter.]

The PRESIDENT. If any one prefers mule-yarn, we shall be glad to hear that side of the question.

Mr. DRAPER. I see Mr. Stiles here, of the Victoria Mills, and Mr. Coburn, of the Hill Manufacturing Company. They have had some for quite a long time, — if you wish, ask those gentlemen about it. I would be glad to hear from anybody, and especially from anybody that has got something that does not go to suit him; because I will give him a call, right away. [Laughter.]

Mr. CHARLES NOURSE. I would like to ask if Mr. Draper can give us any information as to the expense of spinning on frames as compared with mule-spinning.

Mr. DRAPER. So far as I have investigated the subject, I am certain that the expense per pound is considerably less for No. 36 filling. As a matter of course, one man will do his mule-spinning under more favorable circumstances than another; and in another case a man will do his frame-spinning cheaper than another. Mr. Parker had two thousand spindles that he compared with new mules he was spinning on, and I understand him to be pleased with the result. He gave me a statement of it, which was published. But one of the great things about it is the difference in the waste. The amount of waste made in weaving filling spun on frames is only from one-eighth to one-

tenth the amount made in weaving the same quantity when spun on mules; and this difference in waste, as mules are ordinarily run, would make a saving worth from ten to fifteen cents a spindle, per annum, on the amount produced on each frame-spindle. The amount of yarn we get on a bobbin more than on a cop favors the weaving. Mr. Saunders paid weavers, working side by side, one cent per cut less for weaving frame, than for weaving mule-filling. We have had breakages counted. We had a case in Newburyport against some old mules; and I see a gentleman present who may know something about it, and can probably state something about it: but my way is to have one or two men spend their time in observing carefully how this thing works in different places. I understood, that at the Peabody Mills, on account of breakages, they had to change the shuttle four times as often, in comparison with the old filling on the old mules, as they did with that spun on frames; and I think it will average as a rule twice as often. We tested that on the Merrimack, and found there that it was something more than twice as often that we had to change the shuttle; and I believe that rule will hold good as to the average cop-filling in the country.

Mr. BARKER. I notice Mr. Coburn is present, and I would call on Mr. Coburn to address the meeting.

Mr. COBURN. I came in late, and do not know what the question is before the meeting.

The PRESIDENT. The question before us is the comparative merits of frame-spinning and mule-spinning.

Mr. COBURN. Mr. Chairman, I have no intention of speaking at length; but, in all matters of general interest to the business with which I am connected, I have no secrets, and intend to be frank. Some considerable time ago, early after the introduction of the evener which has been referred to by Mr. Draper, we required more filling-yarn than we had mill capacity to produce. We were then making a small quantity of coarse goods. At that time I felt as though it might be allowable to introduce frame-filling into these coarse goods; and we tried it with considerable success, much beyond our expectations. Subsequently we required an increase of filling for fine goods, Nos. 36 and 37; and, with the experience we gained from a series of experiments of putting fine roving on frames which were put in for the coarse filling, sufficient confidence was

secured; so that we put six frames additional on a fine 36+ filling. Subsequently we abandoned the making of coarse goods, and the whole twenty frames are running on 36 and 37 yarn. Without making a long story about it, I will say in a word, that we are entirely satisfied with the results of the experiment; and in view of the experience of some two or three years with a portion of the frames, and some eight to twelve months with the latest of them, if we were going to increase the filling to-day, and had room for mules which we did not have before, we should adopt the frame-filling. It required a little courage, perhaps, or at all events I felt so, when we first introduced frame-filling into fine goods. We had been in the habit of steaming our cops as most of you do; but the bobbin-filling we placed in a hot-air chamber, with experiments as to testing the length of time which would make it sure not to curl and kink, and particularly at those times when the filling gets upon the heavy side of our numbers, as it does sometimes: we ascertained that about two hours' retention in a hot-air chamber would put the filling in a condition entirely safe to weave, and give us no trouble. A suggestion has been made in regard to brown goods. Soon after commencing to spin the frame-filling, an order came to the mill for brown goods. We put some of this frame-filling on to the looms making the style of goods wanted brown. After being woven, the goods were quite critically examined, and compared with same style of goods made with mule-filling; and our judgment was, that the frame-filling made the better goods. Shall be glad to answer any questions.

Mr. ATKINSON. I observe you used the expression "hot-air chamber." Did you mean hot air or steam?

Mr. COBURN. I meant a box heated with a coil; open, no steam; dry air.

Mr. PRAY. What is the temperature of the box?

Mr. COBURN. Well, I do not know, sir, as we have tried that. We put our filling in a box heated with a coil (varying the time of different lots), to test how little time was necessary to set the twist so as to weave well; and to ascertain what influence, if any, the heat had upon the bobbins, with results as I have stated.

Mr. GREENE. We do not do any thing for the benefit of our filling at all, 36 to 37; and we have no trouble at all about kinking.

Mr. DANIELSON. I would say, Mr. President, that, in the Quinebaug Mills, we have been running about seven thousand spindles, spinning 17½, 22, and 26.

The PRESIDENT. Were the goods sold brown?

Mr. DANIELSON. About one-half sold brown; and, while I could detect some difference between the goods made with the ring-filling and those made with the mule-filling, I think I prefer those made with the ring-filling. We put about the same twist in the ring-filling as in the mule-filling, and have had no trouble in any way with the yarn. The principal difficulty we find in spinning on ring-frames is, the demand it creates for small help, which does not increase in our families quite as fast as we increase the ring-spinning. [Laughter.]

The PRESIDENT. Are you using the evener?

Mr. DANIELSON. We are not.

Mr. ATKINSON. I would suggest to Mr. Danielson a way out of that difficulty, — to get Mr. Draper to improve the spoolers, and turn that excess of spooler-help over on to the frames.

Mr. GREENE. Very likely many who use ring-filling have too large a ring. We use one inch and a quarter.

QUESTION. Does Mr. Coburn use the evener on his frame?

Mr. COBURN. I do.

Mr. PRAY. There are several parties here who would like to have Mr. Greene state the amount of twist per inch in his ring-frame spinning.

Mr. GREENE. I would state it to you, but really I do not know.

Mr. DRAPER. For experiment we use 36½ and 37, and we put in twenty-one turns of twist. Another thing I would say in regard to the filling: we give it age, and think in that way the twist sets; and so we avoid any trouble in kinking. We use the oldest one first.

Mr. GOULDING. I would like to ask Mr. Draper what is the effect of the evener; whether it affects the speed of all the rolls, or only one?

Mr. DRAPER. The effect of the evener is upon the front roll alone; and it gives a variation at the extreme speed of about eight per cent, we put it, on No. 36 yarn: so that if every thing else depended simply upon the draught, the yarn might be varied on No. 36 at the extreme point. For an instant it goes on a true taper: and, if every thing was perfect, the thread would

start on the point 36; and it would taper gradually down. When you were winding on the point of the bobbin, it would, supposing every thing right, be 34½; and then it would start on a true taper, and gradually enlarge till you got at a distance of three hundred inches away. It would be perhaps then 37½ where you were winding on the outside of the bobbin. But those who are acquainted with the matter know there are other causes at work in the extreme draught of the traveller that tend to make that yarn more even than it would be — far more even than it would be — without the evener; and it certainly has the effect to make it spin better, that is, break down less, to make the yarn stronger, because, when you go down on the point of the bobbin, you would have less twist and less yarn, and, I think it is safe to say, three times as much pull on it; that is to say, I think the draught on the thread is three times as strong when you are spinning on the barrel of the bobbin as small as we put it. Now, this evener enables us to make the barrel of the bobbin considerably smaller, and have it run well, than we can on the frame without it. I claim anybody can take the ordinary frame, and if they would leave the barrel of the bobbin quite large, — considerably larger than we do, — it would spin very well: but the trouble about that is, you have got to put on very little yarn, and keep doffing frequently, and carrying it back and forth to your looms; and the loom must stop every time. The vital point is, to get the utmost amount of yarn on your bobbin, and run it rapidly, making your yarn as strong as you can so as to bear the draught of the traveller; consequently, the stronger it is the heavier traveller we can carry, and with this evener it enables all those things to work together. It actually builds a better bobbin to draw hard on the barrel; and a better cop; for it makes it hard at that point: and, when you draw over it, the yarn will not be snarled. What would be an evil in ring-spinning with this difference in draught becomes, with this arrangement of the evener, a positive advantage, so far as building a good bobbin to weave is concerned.

Mr. GOULDING. That substantially answers the question I wanted to get at, that the evener makes uneven yarn.

Mr. DRAPER. Did you understand me to say the evener made uneven yarn? I said the yarn would be uneven if there were no causes operating except the small variation of the roll, but I say there are other causes that operate to counteract it.

Mr. GOULDING. Suppose the yarn was put upon the large end, — the driving end of the evening cylinder, — to make 36 yarn by the draught, what yarn will it make on the small end?

Mr. DRAPER. I said we made a variation in the speed at the two extremes of about eight per cent. Now, eight per cent would be one-twelfth part of 36, without splitting hairs; and that would make three numbers of 36, one and a half on each side of the centre.

Mr. GOULDING. I simply recognize Mr. Draper's disinterestedness in introducing these new things, and I think that a vote could be taken of these manufacturers here to-day that Mr. Draper has done us great benefit in a good many ways; but I have failed to recognize the value of this evener in making filling. I had two of the frames in the Androscoggin Mills, and ran them for six months, and experimented on them in various ways. Among the things we did do with the evener was, to run the frames a while with the belt at one end of the evener, and sized the yarn; and then on the other end we found four numbers. We took the space that the band travelled over on the cylinder where the band is arranged to run, and between those extremes we found four numbers difference. Now, it may be necessary to make spinning-yarn to that extent uneven to make a bobbin; but I want to suggest to Mr. Draper here, while the subject is up, that I hope he will spend another twenty thousand dollars in getting at some means to make perfect yarn before he ends his work.

Mr. DRAPER. I will be bound to make more perfect yarn than you can on any machine you have got. [Laughter and applause.] The father of Mr. Kilburn who presides here to-day told me that somebody came to him with this idea of uneven yarn; and he said, "Let us find out about this." He said he sent for Mr. ——, and had brought in a certain quantity of yarn made from mules and some made from frames. Said he, "I took the yarn, and brought it out; and the gentleman who was talking with me pointed out a small place on the frame-yarn, and I pointed out a smaller place on the mule-yarn. Then he pointed out a large place on the frame-yarn, and I pointed out a larger place on the mule-yarn;" and I believe that is true.

Mr. GOULDING. Undoubtedly you will be able to find these places on any yarn. That is the defect of the spinning. If the

gentleman introduces the system here this morning, that the extra draught on the bobbin when spinning has a tendency to even the yarn, to make evener and better yarn, or to take uneven yarn and make it even, we have got a new thing to talk about; and I would like to have him illustrate further, if he can make even yarn out of uneven yarn.

Mr. DRAPER. There is one other thing about it that is material, and I think the critical gentleman will agree with me, and that is this, that we can make yarn of evener twist, taking a given length of six inches, divided up into inches, on the frame, than it is possible to make on mules, when he admits you have larger places on all yarn, one place larger than another. We were told we could not make cotton-flannel on this frame; that we could not spin it so it could be carded. Well, the thing has been tried; and there is a good deal of cotton being made. The Nashua Manufacturing Company have made some on this frame, and finished it; and they said it was so much better that every one could pick it out. That set me to thinking how could it be any better. Well, it is very easy when you consider. Now, you draw out a string here with a mule sixty inches long, and you twist it; and some places are bigger than others. What is the result? Why, your twist runs into the small places until it will not take any more; and it leaves the large places with very little, or none. On the small places you have got sixty inches, which take up all the surplus. Now, when you come to the ring-frame, you have not more than six inches exposed on the point of the bobbin: it cannot run any surplus beyond that. Now, I would like to have the gentleman say whether it is not an advantage. You take a black roving and white one and put them together, and see where your twist runs, and see if it is not an important matter to get an even twist. If he can, from his own experience, demonstrate that is not the case, I would like to hear from him.

Mr. GOULDING. I do not wish to continue this discussion; but, for fear that I may be misunderstood, I will say at once that I am in favor of spinning filling on frames. I would not put in mules, nor recommend them to anybody else. Our experience with frames satisfies us that they give very much better yarn, weave better, and give better cloth, and every thing of that kind: but I do say, in confirmation of what we have heard, that we had one or two Fales & Jenks' frames made

with the eveners; but we could not successfully use the eveners; and Mr. Draper's man came there, and said we did not know any thing about it; and we were willing to plead guilty to that: but we kept on trying; and his man fixed it, and left us. Still, we could not succeed in spinning No. 28½ and 36 filling with the evener; and when we stopped the evener, and put the belt in one place, and kept it there, we succeeded splendidly in making filling to our entire satisfaction. [Applause.]

Mr. GREENE. Every one conversant with ring-frame spinning by the old-fashioned mode knows that the yarn is slacker twisted, and finest when the yarn is on the bare bobbin.

Mr. GOULDING. I would not either deny it or admit it. I do not know. I would take your word for it.

Mr. GREENE. No one can deny it, because there is less twist and more draught. Now comes the question whether it had not better be a little coarser where the greatest strain is going to be on it, in order to run it better? If Mr. Draper has too much variation, perhaps he had better change it; but certainly that evener can be fixed so as to make the yarn evener than you can without it.

Mr. GOULDING. That was not our experience.

[At this point, Mr. Greene and Mr. Barrows, and one or two others, engaged in an informal, and, to the stenographer, an inaudible, conversation on the subject under discussion.]

Mr. GARSED. Mr. Chairman, many years ago, say, at least, fifteen, we spun for many months Canton flannel filling No. 10, with seven and a half turns of twist, on the ordinary ring-frame, with one and nine-sixteenths rings; and quite recently, I should say within three years, probably, the question came from New England to the Bridesburg Manufacturing Company, "Can you make Canton flannel filling on a ring-frame?" They applied to me. I replied, "Yes," and made quite a number of pounds of Canton flannel filling of No. 10, with seven and a half turns of twist, on the ordinary ring-frame, with a positively-driven bobbin. Some years ago, probably three or four, we had an application from Fall River to spin filling for print cloths; No. 30, I believe. The Bridesburg Company again applied to us. I requested them to send from Fall River some of their own roving, — from what mill I do not remember now; and we spun that into thirty-threes (I am speaking from memory), I think sixteen and a half turns per inch. At all events, it

was half a turn per inch less than the mule-yarn. That was on an ordinary ring-frame, without any embellishment or any alteration, other than a plain spindle, positively-driven bobbin, and six-inch traverse. Now, I would like to ask Col. Barrows, — because I was at the Willimantic Company's mill some years ago, and saw them spin No. 60 on an inch and a half ring, before the modern practice of ring-frame spinning; and I am confident it was prior to any of the modern spindles, the Sawyer, Rabbeth, my own, or any others, — I would like to ask how much further they have gone since, in spinning fine yarn on ring-frames?

Mr. BARROWS. I think the Willimantic Company have spun numbers from 45 to 60 on the old ring-frame. They were spinning before I began with the company, and that is seven years ago. But I am quite confident that they spun on the frame before the Sawyer spindle was known; and I am positive that they spun a number of years after the Sawyer spindle was known, on that frame. We have since taken all the old spindles out, and put in either the Sawyer or the Rabbeth in our new mill. We regularly spin on the Rabbeth spindle from No. 80 to 140. Mr. Draper is very persistent; and it is possible we have some frames with eveners on, I am not sure. He knows better than I do about it.

Mr. DRAPER. I was not aware that the Willimantic Company had it on. I do not think you have. Your spinning-warp is different from the filling, at any rate.

Mr. BARROWS. We make a constant practice of spinning 120 on the Rabbeth spindle. In our new mills there are no mules whatever.

The PRESIDENT. What is the size of the ring you use?

Mr. BARROWS. An inch and a quarter.

The PRESIDENT. What is the size of the barrel of the bobbin?

Mr. BARROWS. I cannot tell you, sir. We have spun No. 350 on a ring-spindle and specially-made bobbin, for the Atlanta Cotton Exposition; and we have spun some still finer than that, but not a full bobbin: 350 is the finest full bobbin we have made.

Mr. DRAPER. I want to ask one question. Is there any gentleman here that makes a single thread of yarn that would reach from one end of this room to the other (about seventy-

five or eighty feet), that does not vary more than four per cent in its size in some places from others, in that length? If there is such yarn made, I would go a thousand miles to see it.

Mr. GARSED. I only rise, Mr. Chairman, so as not to be misunderstood as to the desirability of an evening motion for a ring-frame. In England, I think as early as 1852, probably in 1854, Messrs. Higgins spun No. 50's on a flyer-throstle arranged with an evening motion similar to the English fly-frame; and I think the frame ran for forty-eight hours and never broke a thread; although I am speaking from memory. That shows how desirable it would be to have just what my friend Draper is trying to get at. The reason it was not carried out is the difficulty of applying a differential motion to all the spindles of the spinning-frame. So you see it is important to get this machine, but we make out pretty well without it. If the Willimantic Company can spin, as has been said, 60 on the old-fashioned frame satisfactorily,—and I think their thread stands pretty well in the market,—it seems to me we can make a thread good enough without the differential motion.

Mr. DRAPER. One single word. The Willimantic people spin on the barrel of the bobbin, that is five-eighths of an inch in diameter, or more; and we have one that is only a quarter of an inch in diameter.

Mr. ATKINSON. I did not intend to say a word; but the experience thus far given has related to medium yarn, and to bleached cotton or thread. Many years ago, in one of the factories of which I was treasurer, we needed additional filling for brown goods, I think No. 22 filling,—22 or 26. We put in the common Saco Water Power Company's ring-frame, and made the filling upon that. The goods were carefully kept separate for a while until it was determined that there was no practical difference in the market value, and since then they have been merged with the regular goods for sale in the brown. I then came to the conclusion, which others seemed to be reaching, that the mule was dying a slow death for all numbers below 30's and perhaps 40's. I am confirmed to-day in that conviction of many years since. I knew of another case about that time where a contract had been made for mules on very coarse goods. A strike among the mule-spinners warned the treasurer to give up the mules, and pay a forfeit on his mule contract. He did so, and substituted the common ring-frame, and has been

running them ever since on common filling for coarse export goods.

Mr. HIGGINS. Some eleven years ago I went to the mill where I now am, and they had eveners on the warp-frames. I examined them, and I found that they increased the evil they were designed to cure. In other words, the variation was two or three times as much with the eveners as without. I took them off. When the filling-frame came along, I secured one, and found that the evener not only varied the twist but the draught; and the thread was made coarser, at the same time increasing the twist; and I decided not to have the evener. I started the frame on No. 36, and afterwards ran No. 37. It worked remarkably well. We placed the twist as near the mules as possible. We had nineteen and a fourth turns in the No. 36. We added afterwards another frame, and, still later, another, and so on. We have had very good success with it indeed.

Mr. GREENE. With a frame without the evener, I understand the yarn is going to be finest where the greatest strain is. Would you rather have it finest where the greatest strain is, or coarsest where the greatest strain is? That is a simple question.

A MEMBER. Mr. Goulding says he sized the yarn when the belt was at the extreme point of the cone. Now, did he size the yarn at the extreme circumference on the bobbin, — on an empty bobbin or a full bobbin?

Mr. GOULDING. We run the bobbin full on both ends of the cone.

[The President then asked if any gentleman present had had experience with traversing flyer-boards; and Mr. Birkenhead gave his experience in relation thereto, accompanying his remarks with blackboard illustrations, in a manner intelligible to those who saw as well as heard, but in a manner not to be reported.]

Mr. HIGGINS. Some eight or nine years ago we put in our first Sawyer spindle. There are fourteen, one hundred and sixty-spindle, frames. We had trouble running them. The traveller that did not draw the thread down, allowed it to kink before the bobbin was full. Then we began to experiment. We arranged the guide-board to traverse, and that cured the evil; and the frames ran well.

The PRESIDENT. Are you still running them?

Mr. Higgins. We are not running them. Afterwards we changed the rest of the spindles,—putting in what we called the modified spindle; at the same time increasing the diameter of the rolls.

Mr. Mayor then addressed the meeting, making reference to machines and sketches, and said in closing, that from recent visits which he had made to England, he knew ring-spinning was increasing amazingly there.

Mr. Atkinson. As I have observed the battle of the spindles, from a theorist's stand-point, a good many years, it has often occurred to me, and I have told Mr. Draper, that he and his associates were turning their attention too much to fine points in the positive mechanism of the machines, intending to reach desirable ends, but ends which are not desirable to reach by increasing the complexity of the machine. You may pay more for the gain in complexity, wear and tear, and vibration of the machine than the object aimed at is worth. Now, then, it appears that sufficiently good filling is, and can be, spun in the simplest form of ring-frame. I now suggest, that, while an alternate evener is among the most desirable things, there are yet several other points to be covered in the art of spinning more desirable than the evener: and I put questions in my usual way, sir, whether the condition of the atmosphere, whether the good or bad condition of the top-roll, whether the rough and unfit method of weighting, as compared with a proper and judicious method of weighting, do not make greater differences in the evenness and quality of the yarn than almost any one of these fine points which have been discussed to-day in the matter of applying eveners or not? According to my observation the tendency is this, to work mechanically, and not to pay attention enough to the general conditions under which existing machines are run. I have been utterly astonished at the rough castings and unevenness of the weights by which the top-rolls are held, and at the enormous variations which are permitted in factories where close attention appears to be paid to some of these minute points of the mechanism. It seems to me that a great many of your faults are faults that are covered up and not discussed, and that they decidedly need more consideration than these minute questions which we have been on to-day.[1]

[1] According to Bowman's recent work upon the cotton fibre, lately published in England, an average quality of yarn of medium number represents about one-fifth part of the normal strength of the separate fibres of which it is composed;

Mr. GARSED. Mr. Chairman, inasmuch as this spinning question and guide-board question has come up now, is there any gentleman in the room who has had any experience with the old Dodge spinning-frame? I ask, because I want to know from him whether the guide-board of that frame did not lift with the ring-rail?

Mr. DRAPER. The patent shows that it did.

Mr. GARSED. Prior to that machine (the Dodge Frame), the Matteawan Company made a ring spinning-frame, with long spindles similar to mule-spindles, with a wire drawn the length of the frame, and exactly over the centre of the spindles, and about one inch above them. There was no other guide laterally. They thought by this means to make soft yarn, but it proved a failure. No more beautiful machine in design and workmanship had been made up to the time of its introduction than the Dodge Cop-spinner. It failed for want of a sufficient diameter of bobbin to drive the traveller.

that is to say, a No. 20 yarn contains about two hundred and forty fibres. If each of these fibres were in its normal condition, and of the average strength of mature cotton, the yarn would be five times as strong as it is. The loss is, of course, largely owing to the unequal tension upon the fibres; but probably the greater part of the loss of strength is due, —

1st, To the injury done to the cotton by the saw-gin.

2d, To the injury done in picking and carding.

3d, To the injury done in the several processes of drawing under heavy weights from the railway-head to the spinning-frame inclusive.

From the theoretical stand-point, the effect of separating the fibre from the seed, to which it is often tenaciously attached, by catching it across the middle with the tooth of a saw, and doubling it up as it passes through the wires, must do a great deal of injury. From a similar stand-point, the effect of metal blades in the pickers, revolving at a speed of over half a mile a minute, and striking the fibre as it leaves the feed-rolls, must do more or less injury. From the same stand-point, the card is not a scientific machine, however well it may serve its purpose. The fibres are straightened, and laid parallel upon the main cylinder, probably with little if any injury; but the removal from the main cylinder to the doffer begins to upset and snarl, and the comb completes this injurious work in greater or less degree according to the skill with which the doffer and the comb are adjusted.

Whoever invents a device for removing cotton fibres from the main cylinder without altering their direction, or parallel condition, will enable the spinner to dispense with a very large portion of the process of drawing and doubling, whether on the drawing-frame or the roving-frame. As the strand now comes, however, from the doffer-comb, snarled and crossed almost as much as it was when it left the saw-gin, it is put through the several drawing-frames and roving-frames under heavy weights, in order to straighten and even it; and in these processes the fibres grind against each other, and are abraded, flattened, and weakened. The wonder is, that even so much strength is left after such rude treatment.

If there is any reason in these exceptions to ordinary methods, it will be apparent that there is yet almost as much room for improvement in the science of

Mr. ATKINSON. I omitted one of the chief causes of variation, the variation of the bands, and the want of a positive or even tension.

Mr. GARSED. Whenever a member spins successfully upon quarter-inch spindles with a ring-frame, I am coming immediately to see it, if I can; for the simple reason, it must necessarily wind up: the traveller cannot be driven. My friend Atkinson has put the matter clearly before you. The tendency must be in the direction of simplicity. You must not complicate machines. If you are going to be successful cotton spinners and manufacturers, if the yarn is good enough, keep on, and take away from the spinning-frame some of its complexity rather than add to it. If you can make a spinning-frame so simple that a child can tend more spindles, that is a matter of importance.

Mr. BIRKENHEAD. Will Mr. Garsed explain to the members, in regard to this question of traversing thread-board, the principle on which it works, both practically and theoretically?

Mr. GARSED. I have had considerable experience with different ring spinning-frames; and I have always noticed, that

cotton-spinning in the future as there has been in the past, even after the cotton has been received in the picker-room of the factory.

It is very safe for the theorist to suggest these faults; it may be unsafe for the practical man who is engaged in the daily operation of the factory to attempt experiments for their remedy; but he will be the true practical man, who, having satisfied himself that the theory respecting the faults is grounded on the sufficient observation of facts, proceeds to invent devices, and apply them with a view to the remedy.

The fault does not end at the spinning-frame; the loom itself is subject to very grave exceptions, and will some time or other be so improved or so altered as to do away with its present rough action and rude clatter.

In what manner a positive and even rotary motion is to be substituted for the vibration of the lathe, does not yet appear; but it is a singular fact that there has been no improvement in the fundamental principle of the saw-gin, of spinning by rollers, or the motion of the lathe of the loom, since they were first invented and applied, — the two former about one hundred years ago, and the latter in prehistoric times: yet all are imperfect in their construction, and injurious in their action.

With respect to the process of ginning, the writer has ventured to say that the whole crop of cotton of the United States is depreciated one cent a pound between the field and the factory, and that this depreciation is compassed by the expenditure of twice or three times the amount of labor which ought to be devoted to the several processes to which the cotton is subjected. The only criticism which has been made by several persons, but especially by an English machinist who had constructed many cotton-ginning establishments in Egypt, of a thoroughly adequate kind, has been that the undersigned ought to have said two cents a pound where he did say one cent. One cent a pound of the cotton crop of the United States amounts to $30,000,000 a year. The next question therefore is, Who will occupy this field?

when the angle from the roller to the guide-wire was too flat, that is, when the rollers would be too low down, there was bad spinning, for the reason that the twist is not permitted to run into the bite of the roller. It is stopped, either by the fluted roller, or by the action of the guide-wire at the less angle. An angle of 22 in one case and 45 in the other makes all the difference in spinning, for the reason, as I said before, the twist cannot run up in the bite of the roller; and therefore the machine which has the longer angle is the better of the two. We have to-day a lot of spinning-frames, some 22, that spin badly from that very reason.

Mr. GREENE. I have had a good deal of experience with ring-frames, and the worst frames I ever had were where the thread ran the most directly from the top of the spindle to the bite of the roller.

The PRESIDENT. I remember an instance where spinning-frames were built for another mill, and we bought them as they were. The rolls were brought forward within an inch and a half of the guide-wire. The front roll was only one and a half inches from a perpendicular line drawn through the guide-wire. It was a thing to which I gave no attention in purchasing the frames. We started them up, and had a great deal of difficulty with them for a few years. They were a source of endless complaint on the part of our overseer, and I came to the conclusion I had made a very grave mistake in buying these frames without due consideration. The frames were built at the Lowell Machine Shop, and had the Sawyer spindle in them. I took out the Sawyer spindle, and put in the Rabbeth; and in doing so I changed the distance from the top of the spindle to the guide-wire materially; and the result of that change was, when we got travellers adapted to the work, our men pronounced them the best running frames we had in the mill. I think there is a great deal to be learned in regard to the proper adjustment of the parts one to the other. Within a year and a half I visited the Berkley Mill, between Lonsdale and Ashton, in Rhode Island; and there I found traversing guide-boards at work on No. 85 yarn, I think. I also saw them in use on 50's, and I think all the way up to 120's. I was told by the manager of the mill, who had devised this special arrangement of traversing guide-board for himself, that he found very great benefit from it; and I was so impressed by

what I saw and what he told me at that time, that I have a strong feeling within me that this is a matter of vital importance, and is worthy the attention of every one engaged in spinning yarn, especially the spinners upon ring-frames.

Mr. GOULDING. I suggest that the subject of spinning be laid on the table for the present, and we take up the next order of business.

The PRESIDENT. The next order of business is the presentation by Mr. Hill of his paper upon "Methods of Transmitting Power by Belts," but Mr. Hill prefers to avail himself of the intermission at noon to adjust his models for exhibition; and therefore there is no other business before the meeting, I believe, except the report of the delegates to the Atlanta Exposition.

The Association then voted to hear the report of delegates to the Atlanta Exposition; and the President called on Mr. Atkinson to say whether the delegates organized themselves with a chairman, and, if not, then the subject might be presented in an informal way.

Mr. ATKINSON. I fear, sir, that part of the work was somewhat overlooked, there was so much else to be done. They were organized in a certain way, part of the time by volunteer chairmen, and part of the time under the efficient lead of Mr. Garsed; but I believe that no action has been taken for a joint report. I would therefore suggest that you call upon the delegates in detail, rather than for a joint report. A full report could not be made, and cannot be made until another delegation shall have visited Atlanta and returned. It is hoped that that delegation will be appointed to-day. I should very much prefer that others should precede myself. I have a few matters that I will bring before you, but I would very much prefer that delegates whose views would not be biassed by any previous connection with the Exposition should make their statement before I say any thing further. I think, sir, that Col. Barrows has had —

Mr. BARROWS. I was not a delegate.

MR. ATKINSON. Mr. Barrows suggests that he was not a delegate, but at the same time he has had a wider experience at Atlanta than any of us who have spent but a little time there.

The PRESIDENT. I suppose it would be in order to hear any one who may have information in relation to what they saw at Atlanta at the Exposition. I will call upon Mr. Goulding.

Mr. GOULDING. Unfortunately I was in a condition not to be able to go with the committee to Atlanta, and of course I have not a word to say. I know that Mr. Garsed can always say something on the subject. This subject seems to start a little hard, and I would like to see him start it.

Mr. GARSED. Mr. Chairman, I came here to-day entirely unprepared to say any thing in an official capacity as to the Atlanta Exposition; but, as my friend Mr. Goulding said, something always can be said upon such occasions. First, I desire to say here that no gentlemen could have received a more kindly reception at the hands of the people of Atlanta than your delegation received, I care not what quarter of the globe they went from. So much for our reception. We found, to our surprise, one of the most extensive exhibits, excepting the Centennial, that has ever been shown in this country. The first was the cotton, in which we are all interested; which we found, growing, of every description known on the habitable globe. Our aim in going to Atlanta was to look at the cotton, and to its preparation. I took great interest in going to the cotton-field, and examining the different kinds. Then, there was the cleaning of the cotton, prior to its ginning. There we found some very efficient cheap machines. They seemed to do the work reasonably well, but not as well as it ought to be done. The next was the ginning subject. I went to Atlanta with a clear conviction in my own mind, after a great deal of experience in cotton-ginning, in favor of the roller-gin, because I believed it would give us straighter cotton, — cotton worth more money, and less torn fibres, than we had by the saw-gin. I would not like to say, if the saw-gin was in perfect order, that we should not have a great deal better cotton than we have; but the saw-gin falls into the hands of unmechanical men, that know nothing whatever of machinery; who hardly know why the saw-gin takes the cotton from the seed, and is driven at all kinds of speed, because no man seems to have thought it worth his while to stamp upon the gin-frame itself the speed at which it should run; and so you find it running twenty-five per cent faster than it ought to be. That would not be the case with the roller-gin. We watched it through the different operations day after day; and I would say here, that the planters seemed to evince very great interest in the matter, and often questioned us, either on the subject of the

gin itself, or cotton-fibre. They followed us into the fields; and I found them desirous, in every instance, of getting information. We suggested, that, in packing the cotton, a sample should be taken from the middle of the bale to sell by, or to fix the grade; the planter to put on his name and post-office address. By this means, when the cotton was opened, should the manufacturer desire to compliment, or suggest improvements, he could do so direct to the grower, and to the benefit of both user and planter. I think the seed is sown for a great deal better ginned cotton, and a great deal better packed cotton, and a great deal more cotton of a better fibre, than has been grown in this country before. [Applause.] We showed them the difficulties we labor under at the North; and, to my agreeable surprise, I found the men willing to take hold and help us out, to the best of their ability. We found cotton growing there that will rival the Egyptian cotton, known as the Ozier Silk Cotton, which is very long, very silky, and very strong. If that cotton should be kept by itself, I believe an achievement will be brought about by the Atlanta Exposition which would never have been brought about in twenty years under other circumstances. We found also there the packing of cotton by means of the Dederick press. But the difficulty seems to be the poverty of the planter. On the one hand is his poverty, and on the other hand is the utter want of mechanical knowledge. The cotton is handed over to the plantation men, who are without any knowledge whatever of the machine, and knowledge of the causes that make good or bad cotton. And when we talked to them about the fibre, and packing cotton from the meadow and upland all in the same bale, and packing different lengths together, they did not know even how to examine the cotton. One man followed me around there — a gentleman, sir, of education — for three days; and every time I tried the length of the staple, and he could bring a lot of planters together, he said, "Won't you show us how you do that?" He pointed to my shirt, and said, "That is what we want, — white cotton." The cotton is sold upon its merits as to appearance, not upon its staple, not upon the size of the fibre, or its uniformity of length; but it is sold, graded, as you all know here, upon its appearance, whether it be white or stained, — stained by extreme ginning upon the cotton-seed, giving it a yellow appearance. I believe all that is going to be remedied,

and that in a great deal shorter time than we have ever dreamed of in our philosophy. I think it is a revolution that will not go backward. I believe they will keep the different kinds of cotton separate, and will have intelligent men pack it, and get the full value of each class of cotton by itself.

Then, there is another subject we may well have the benefit of. A great deal has been said upon the subject of Southern manufactures, and I am willing to say here that I have been compelled to change my views very materially of the chance of the Southern manufacturer being rather more of a competitor than we are anxious to have. I found several mills that were run with quite as efficient help as any mill that I know of in New England, where each individual did as much work, and for less money, than they do in New England or in Pennsylvania; and it was as well done. I am now speaking probably of the most trying point, namely, upon colored goods. I found a mill of fifteen hundred or more looms working entirely upon colored goods, where the competition with us Northern manufacturers was more than we want. That is, they can make the goods quite as cheap, if not cheaper than we can, getting the benefit of one cent a pound on the cost of transportation of the cotton from the South to New England, which is about six and a half per cent of the entire product. They have that advantage, if they sell their goods at home, as this particular mill did. They deliver them to the railroad station as ordered from the different parts of the country or by their agent on the road. Prior to this trip I had not been in that city for twenty years. When you look at the water — five thousand horse-power — falling over the dam at Augusta, not a spindle turned by it, all wasted; three or four thousand horse-power at Columbus wasted, — you will realize what facilities they have for running machinery. The point is, they have the people; they require less to keep them, — they require less fuel, less clothing; and they live in miserable houses. I saw eight blocks of houses — a pair of houses being a block — that cost ninety-two dollars a block to build them, all told. [Laughter.] It sounds odd to talk of having houses built for ninety-two dollars a block.

QUESTION. What place was that?

Mr. GARSED. That is near Montgomery, within a mile and a half. A very excellent and respectable house is built in Chat-

tanooga for two hundred and twenty dollars. That has glass windows, but the first ones I mentioned had no glass in them. [Laughter.] They had a sliding door instead of a window: therefore there is no trouble about breaking the windows. They were built upon six piers, eighteen inches square; no garret, no cellar, and only two rooms; but people live in these houses, and there is the competition you have to meet. With a thousand cotton-bales lying outside the fence of the mill I spoke of, all they have to do is to buy as many as they want, and simply roll them into the mill-yard a hundred feet away, with all the means of transportation at hand. If they send the goods to the North, the cost of transportation must be deducted. I might as well say here that this mill has a dye-house and finishing appliances that are not excelled by any mill on the American continent. They are right up to time: cranes to remove their yarn from one kier to another; tracks to turn round; one man instead of half a dozen men pulling them around; vats made of cast-iron, and cemented thoroughly. In other words, it is built up to stay there, not to be renewed every two or three years. It has the best modern appliances and best modern machinery. A mill is being built at Augusta known as the Sibley Mill, calculated for thirty thousand spindles. They are putting in twenty thousand. The horse-power will cost then five dollars per annum, with no taxes; and that mill is one hundred and eighty miles nearer New York than the one I have been speaking of. It is from such mills at such points that we may expect competition on coarse goods, and at a very early day.

But I think there is room enough after all. The great thing for us, and I would call the attention of every gentleman to it, is, when he has occasion to write South, to insist upon the kind of cotton he wants, and the improvements in cotton, until the work we have begun will be carried forward successfully.

QUESTION. Can you tell us the cost per spindle of the new Sibley Mill?

Mr. GARSED. No, sir, I cannot.

A MEMBER. The new Sibley Mill, if it is managed as well, and run as it has been since its construction, will never be a competitor with us. It is a mill five hundred and eighty feet in length, seventy-eight feet wide, four stories high, and designed for thirty-three thousand spindles. They purpose put-

ting in twenty-two thousand now. Mr. Foster was one of the building committee, and seemed to know the most of anybody that I could find; and when I asked him in relation to the spindles, he said, that when the twenty-two thousand spindles were put in, and the mill was running with them, it would use up the entire capital of $900,000. Some of our parties in Fall River were told, that when it was full, with thirty-three thousand, it would cost $1,050,000. The brick upon the ground, they told me, cost five dollars and a half a thousand. The hard pine it was built of cost from twelve to fourteen dollars per thousand. I was told that all the fancy work there was about it had not cost five hundred dollars; but I was very much amused at the extravagant way in which they had built this Sibley Mill, which cost $900,000, to operate twenty-two thousand spindles. We did not go into other Augusta mills, our time being consumed with other matters. There was one thing rather peculiar, that in Augusta, as we went up the canal, there were numerous buoys, consisting of empty champagne bottles, the entire length.

Mr. GARSED. Was that after you went there, or before? [Laughter.]

Mr. ATKINSON. I desire to say a few words to those of you who may yet visit the Atlanta Exposition. I think it will be too late for you to see the varieties of cotton growing in the field even as well as we saw them; and we did not see them in very good condition, for, unfortunately, the gentleman in charge, an official of the State of Georgia, had not the practical experience in dealing with worms that might have been desired; and the worms had swept over that field, and had done a great deal of mischief. I learned in that connection that there is an injury done by the worm of which I was not aware, and of which I think many of you are not aware; namely, that a very large proportion of the leaf which we find in the cotton is caused by the worm, who bites off more than he can chew, destroying the edges of the leaf next the eaten part; which drops off and works into the cotton; making this "trash," which is the most difficult to remove: and therefore the treatment of the worm question has an importance far beyond the mere question of quantity.

Mr. GREENE. I would like to ask if you can explain why almost always cotton that is leafy is very good?

Mr. ATKINSON. I suppose there is only a general explanation to be given of that: that by planting coarse, rank cotton on bottom lands, the quantity of cotton is greater, and cannot be picked clean. I have no other solution of the question. I have always observed that extra staple cotton came from the bottoms where the growth was rank, and where they had to pick fast in order to pick at all.

Mr. BARROWS. Is it not very largely due to the system of ginning?

Mr. ATKINSON. I think it may be, in part.

Mr. BARROWS. I think some experiments I made proved that very clearly.

Mr. ATKINSON. Col. Barrows suggests that the saw-gin, not being adapted in any way to the long staple cotton, not only injures the fibre, but carries a great deal of dirt and leaf into the cotton, which might be left behind by the roller-gin.

The first subject to which I call your attention may sound strangely to you. You have all heard of the Clement attachment. Now, while the Clement attachment is not to be considered as suitable for working any very large amount of cotton into a large amount of yarn; and although it has its place only with respect to small yarn-mills, and especially to mills supplying the neighborhood; there are yet some points in connection with the Clement attachment which it seemed to me were worthy the attention of every cotton-spinner with a view to their application elsewhere than in that particular adjustment of a cotton-gin to a cotton-card. The prime secret of the Clement attachment, and of the clean and good yarn which is made upon it, is, that the cotton itself is cleaned in the seed before it goes to the gin. Even good cotton is thus treated; and I am quite sure you will be interested in witnessing the work upon the cotton, which I have here. [Mr. Atkinson exhibited various samples of cotton.] There is the cotton in the seed before it has passed through this simple little cleaner, and there is the cotton in the seed after it has passed through the cleaner. The cleaner is a very cheap, simple, and effective machine; and you will observe that it has not only taken the dust and dirt out, but it has prepared the fibre for the gin in a thoroughly useful and effective way. That cleaned cotton is then fed upon an apron by weight, and carried to the small saw-gin, which is substantially the attachment. That little gin works very slowly,

and delivers the fibre in the very best manner, not directly to the card, but by means of a brush and an apparatus equivalent to that of a slight combing. In the cleaning of the cotton in the seed, and in that method of delivering fibre from this little gin to the card, lies the secret of the possibility of carding one hundred pounds a day on the Foss & Pevey card, to which the Clement attachment was applied. The sliver from that Clement attachment, worked at that speed, I have here in this can which our Mr. Woodbury brought up; which, as you see, has a very great amount of strength for a strand that has been delivered from a card to a single head of drawing, drawing one into four. That sliver is sometimes worked from a single card through the slubber and fly-frame, directly to the spinning-frame. In a larger mill it is carried by a small railway to a railway-head, and doubled, and treated in the ordinary method, but with very little drawing; and from it come these substantial, good, clean, and excellent yarns. One sample of the yarn I sent to Mr. Goodwin at Indian Orchard, to be tested at his establishment. I am sorry it has not been returned; but his report was as follows: "No. 13 yarn; very even, smooth, and clean; twist per inch, twelve; average strength, ninety-three pounds," — a fairly strong yarn. I therefore advise those who may go there, to examine the Clement attachment, not with reference to itself, but with reference to what it may suggest.

Now, gentlemen, the next point to which your attention should be immediately called, when you are there, is the various machines — of which, I think, my associates only saw one — for cleaning cotton in the seed, especially very dirty and trashy cotton. We took most notice of the Clark cotton-cleaner, made at Atlanta. Last year, when I first addressed the people of Atlanta, the Clark cotton-cleaner was hardly known, and its representatives had almost despaired of being able to introduce it; but the large amount of dusty and sandy trashy cotton which was left over to the very end of last season, has, as I have often predicted, taught the lesson: and to-day the makers of the Clark cotton-cleaner cannot supply the demand. The price of the Clark cleaner is seventy-five dollars.[1]

[1] After the committee left, the Ralston cotton-cleaner was brought to the Exhibition from Texas. This machine was fully described before this Association three or four years since. It appears to excel all others in the conversion of what has been heretofore worthless trash into an even grade of ordinary cotton.

To show you, gentlemen, what can be done, I will state that one of the ex-governors and myself were challenged to pick some cotton in a cotton-field, where it had been left through the season, to show what it would make. It had been storm-beaten, and had become very dirty. There is some of the cotton which we picked. The colored gentleman who bossed our work [laughter] was asked whether he did not think "massa" would have whipped him, in the old times, if he had not picked better than we did; and he reckoned he would. There is the cotton which the ex-governor and myself picked. I then carried it to the Clark cleaner. You will see the cotton was in a very bad condition by the condition of the seed, which is there. I then took it to the Platt roller-gin, and it was ginned upon it. There it is, ginned. That cop was spun on a spinning-wheel, by one of the old spinsters, who was operating a wheel. Alongside of that cop, made from the Atkinson trash, is this little part of a cop of No. 26, spun by the same old lady, upon the same wheel, given to me by Major Barrows, within whose rail this work was being done.

Now, I had no opportunity to examine into the merits of these respective machines. There are several others, some of which form a customary part of the cotton-gins as they are sold, and are being worked as a customary part of the ginning of cotton; and you will get the benefit of them. It appears, that when this dirty and trashy cotton began to come back upon the hands of the growers, and to be thoroughly examined, some of them had the wit to weigh the dirty bale and weigh the clean bale; and they found that each quarter of a cent's worth of dirt that they left in the bale cost them a cent in the grade. They are now more anxious to clean their cotton than they ever were before; but, at the same time, they allege, and I now quote Mr. J. B. Jones, one of the most intelligent, active-minded, and progressive men whom you can meet there, "Massachusetts has sold us all her shoddy, and has bought all our trash at our highest prices. We know better. We prefer to make good cotton; but under the condition under which our cotton has been brought together at the corner stores, and merged together in lots, without discrimination, and never sorted or classed where it could do us any benefit, it has paid us, up to this last year, a great deal better to make trash than to pay attention and labor to the making of good cotton. This is the first

opportunity that ever happened when we, who know how to make good cotton, and would like to furnish it, provided we can be paid for it, have been able to meet the spinners face to face, and find out what they want, and find out how to reach them. The small growers have been encouraged by the merchant to grow poor cotton, because the buyers are so ignorant of their business. They say, 'An inch thick of clay will bring as much as an unspotted bale.'" And he added, "All this dirty cotton sells best in Massachusetts." [Laughter.] That may be true, and it may not be. Mr. Jones of Burke County, Ga., is to be found in the second story of the main building. He is a seedsman more than a cotton-grower, and his collection of seeds will interest you greatly. Close by his place is the exhibit of Mr. James H. Gorman of Talbot County, with two hundred and sixty-five articles from one farm. The list includes horse-collars made of straw, brooms made by his own hands, and a variety of little domestic manufactures; but the whole collection will surprise you greatly.

Your next point of observation will be, first, the great number of extra staple cottons, the great variety of improved cottons, of which you will find evidence. They are brought there by men who never saw a roller-gin. Col. Ozier, the most successful man of the number, whom I saw just ten minutes as I was leaving Atlanta, said to me he had never before seen a roller-gin, and had no idea that the roller-gin could be applied to green seed-cotton. Here is some of Col. Ozier's extra staple silk cotton, sent by himself, and ginned on a saw-gin. You will see that it was carefully ginned and beautifully prepared; and, if you will examine it carefully, I think you will find that every third fibre was cut by the saw-gin. Here is the finest cotton, furnished by Mr. J. B. Jones. This is now known as "Jones's improved." There it is from the saw-gin, and there it is from the roller-gin; and you can observe the difference in those two staples in their appearance. You will observe that the color of the roller-ginned cotton is not as good, but that the staple is beyond conception better. All that difference in color would disappear in the process of manufacture. Now, whether the roller-gin shall prove to be capable of treating the great commercial crop of green seed-cotton for ordinary use, is a question of quantities not yet determined; but that the introduction of the roller-gin will enable the Southern growers of cotton to pro-

duce a staple for combing and for fine work, which will put us more than even with the supply of Egyptian cotton which England enjoys for those purposes, I think is fully proved, and that the evidence is here. It is very unfortunate that the additional evidence which is on the way is not here. The trial of gins, which was made as a preliminary to the final competition to be held after Dec. 6, did not show comparative results in any suitable way for the singular incident which happened, proving all that Col. Barrows has said, and that I have observed, as to the inability of the grower and planter, with his present light, to determine the value of his cotton in the seed, or even after it is ginned. A reqnest had been made for a uniform lot of seed-cotton, grown on the same field, for this trial of gins. The trial had been completed on two of the gins, and a rather short and inferior staple had been the result. We then came to the third: and, as Col. Barrows and I stood by it, we observed that the cotton was coming out in an entirely different form; and on examination it was seen to be worth two and a half to three cents a pound more than what had been delivered at the two previous trials. On examination it proved to be an entirely different variety of cotton. The advantage was not in the gin, but in the cotton; and the men who had brought that cotton for trial supposed they were delivering the same thing. Now, that is what is happening at every neighborhood gin throughout the South; and that is one great reason that there has been up to this time so little encouragement for the grower to improve his cotton. It is all ginned together; it is all merged together; it goes to the corner grocer at so much a pound; it does not make much difference to him whether it is half a cent more or less, because his profit has been on his goods twenty-five to one hundred per cent. It then goes down to the place where it is finally classed; and there, if the classer knows any thing, it is classed according to the value of the short fibre, and not according to the minimum value of the long fibre.

The PRESIDENT. The hour for the intermission has arrived; but before recess I would like to read a letter which I have received from the South, inviting this Association to send delegates there.

OFFICE OF THE COTTON PLANTERS' ASSOCIATION,
VICKSBURG, MISS., Nov. 23, 1881.

Mr. JNO. KILBURN, *President New England Manufacturers' Association, Lowell, Mass.*

Dear Sir, — Your body is invited and requested to send representatives to the cotton planters' and manufacturers' convention to be held in the city of Atlanta, Dec. 6.

We have every reason to be assured that this convention will be one of the largest of an industrial character ever before assembled in America, and, taken in connection with the Exposition, must prove the most important.

Railroad fares have been reduced, on one train only for the occasion, to one cent per mile each way.

Inquire of your local railroad agents, who will designate the train you are required to take.

Sincerely yours,

F. C. MOREHEAD, *President.*

Mr. PRAY. I am authorized by the City Council of the city of Richmond, Va., to extend an invitation to any delegation which may be appointed by the New England Cotton Manufacturers' Association, to visit Richmond. I have also received a telegram this morning from Richmond, asking how many will be in the party, and when they will arrive in Richmond.

Mr. ATKINSON. Before we adjourn, I would like to complete one statement, that, although this trial of gins was thus inadequate as to any comparison, I requested samples from each gin to be sent here: and they are on the way; but, with the usual slowness of communication between the South and North, they have not yet arrived. I am very sorry; but they will by and by be at my office, where anybody can see them.

[Recess until two o'clock P.M.]

AFTERNOON SESSION.

The Association was called to order at two o'clock by the President.

Mr. ATKINSON. I wish to say to all who have any thing to say in regard to Southern manufacturing, — beware of the newspaper man. Having been first betrayed into a controversy, which I intended to avoid, by the indiscretion of a Southern newspaper, I have of course been obliged to defend my position. This man said that I had alleged that Southern manufacturing could not be successful. Such a remark would of course be an extremely foolish one. There are several successful Southern mills, and there will be others. The point which I make is this: that the undeveloped resources of the South are so immense, and the capital which is required for their development relatively so small, in ratio to the capital required for cotton manufacturing in the large sense, that, whenever the skill and intelligence, especially the mechanical intelligence, of the people are developed in sufficient measure to enable them to establish cotton manufactories, they will by that very process have become aware of so many better opportunities for the use of their capital, in which we Northern men cannot join, that their very prosperity will be the reason why they do not engage in any large measure in cotton manufacturing. So long as their mills of a large size are concentrated at particular points, like unto the concentration which has happened in New England and everywhere else, they will share the general prosperity of cotton manufacturers; so long as their small, scattered mills are confined to supplying yarn for given neighborhoods, they will of course succeed. My judgment is, that while the large undertakings, comprising both spinning and weaving, will tend more and more to concentration in particular places and in very large establishments, the time is coming when the cotton manufacture will differentiate itself exactly in the manner which has happened in Great Britain. The spinner will spin yarn, and the manufacturer will weave the yarn which he buys from the spinner in greater and greater measure. This leads to the possible success of smaller establishments than can now be undertaken where spinning and weaving are combined. In this, again, the opportunity of the South to make yarn will occur;

and they can do that with much less capital, and with much less risk, than to undertake the establishment of great mills. We all know here that no mill to be operated by a corporation ought to be of less capacity than thirty thousand spindles, with its ratable number of looms. As I said before, it would have been desirable to avoid this discussion, — but you, gentlemen, who go South, will find that you cannot avoid it. If you try to keep silent, you will be forced into the discussion of the question.

I have arrayed myself in a new dress, one of the suits that you have heard of, made in a day on the machinery of the Willimantic Linen Company, in order that I might be in proper condition to call upon Col. Barrows, who is obliged to leave in about fifteen minutes, to give his impressions of the Atlanta Exhibition.

Mr. Barrows. As perhaps most of you gentlemen know, my trip to Atlanta was in behalf of the Willimantic Company. Our exhibit there was purely an advertising scheme And, as the Willimantic Company are purchasers only of Sea-Island cotton, at first I was not so much interested in the exhibit of short cotton there: but soon I became acquainted with some of the cotton-planters; and, as I had never seen cotton grown before making this trip to the South, I improved this acquaintance for the sake of getting some general information in reference to cotton and its culture.

After a very short time, the utter ignorance of the small cotton-planter in reference to the cotton staple led me to take an interest in the matter, and look at the cotton, and the manner of handling and working it. It was very soon apparent that the cotton-grower had not the slightest idea of what the cotton manufacturer wanted. His object seemed to be to get about five hundred pounds of something into a bale, and sell it for as much as he could get. The fact that the cotton-purchaser made only from half to three-fourths of a cent difference in the cotton was no inducement to the cotton-grower to try and get a large crop of perfect cotton. The poor, cheap trash, and the poor, miserable system of ginning, would answer as well to the grower, because he could get as much money for his cotton; and that was what he wanted. My judgment in the matter of the growth of cotton is, that it lies in the hands of the cotton-purchaser. If, in purchasing cotton, he would make a proper

distinction between a good article and one that is virtually worthless, the cotton-grower would furnish him with the cotton that he wants, — that he tries after, but does not seem to know how to get. Now, as Mr. Atkinson said this morning, when the tests of the gins were made, the cottons were purchased from a large dealer, at the rate of three and a half cents per pound in the seed, and as nearly alike as possible. After the tests of one or two gins, the difference in the cotton was very noticeable; so much so, as I was expected to test the cotton after it came through the gin, I said there was a remarkable difference in the cotton: and, upon drawing the staple, I called the superintendent, and asked him if he was sure the cotton was the same. He said it was. In making a number of examinations I was decidedly of the opinion that it was different cotton; that there could not be such a uniform difference in the length of the staple, made by the gin itself. I questioned him again; and he was very positive that the cotton was all alike, — grown on one plantation, from one seed. Finally, after talking the thing over with Mr. Atkinson, I sent for the man who furnished the cotton. He said he "wouldn't give a damn: he got three and a half cents a pound for it, and that was all he knew." He got three and a half cents for inch and a half staple and three-quarters inch staple. We took some of this, and ginned it on the roller-gin and on the saw-gin, to show the difference in waste made by the two machines. I think there was about ten per cent more waste taken out by the comb in the saw-ginned than in the roller-ginned cotton.

There is another thing that we noticed, — the great number of times that cotton-growers have been to our people, and asked to have the manner of drawing the staple shown them. I think, as a rule, it is safe to say that the cotton-grower never pulls the staple. None of them acted as if they ever pulled a staple before, and hardly knew what the staple was. I think Mr. Garsed had one gentleman follow him round two days, until he thought he could do as Mr. Garsed did; but he could not really do it. He could only go through the motion. When the machines were tested, — some ten or twelve of them, — there were a number of cotton-factors and ten or fifteen cotton-dealers, as well as these gentlemen interested in the gins themselves, around the gins; and we watched them very carefully: and not in one single case did one of these cotton-grow-

ers, in making up his opinion of the value of the gin, touch the staple and draw it. I watched the test very carefully, as that was the part of the gin where I was stationed. They never pulled the staple at all; and the only way we detected the difference in the two cottons that were being ginned was by my pulling the staple. So it seems to me the greatest amount of good will come out of this Exhibition, if the cotton manufacturers go down there and tell these people what they want. They all want to know. The common expression is, "For God's sake, come down here, and tell us what you want!" They want to get the most out of the cotton, and would, if they knew how to do it. They want to know how to grow it and prepare it, how to bale it and handle it. If you go off in the country, in a ginnery where they prepare the cotton, the crudest and most shiftless methods are adopted. It was suggested by some gentlemen from this Association, who were down there before, that it might be well for a company to be started, — getting a good machine in the first place, — to show them how to gin cotton intelligently, and how to intelligently use the machine. It is safe to say that not one in a hundred of the gins, after they are properly built, are properly run. In a large number of cases they have a mill where there is a mule, or old horse, or ox, or steer, hitched up to a pole; and he walks round the windlass. For a driver, an old negro wench sitting on the ground, when she feels like it, hits the animal; and it starts up, and goes ten paces perhaps: then the gin goes at proper speed. Then, when she takes a chew, or a dip of snuff, the speed goes down. That is the way the business is done.

Mr. Atkinson asked me if I thought that we paid expenses in going down there. I told him, that I had learned enough of what is wanted, of the way cotton is grown, and the way it is handled, to pay for all the trouble. The desire to grow the long-staple cotton, and the ability of the land to produce it, is shown by these samples we have brought here. This sample of Ozier seed was raised on an average of seven hundred pounds of lint to an acre of land. Now, the average, as I understand, is less than a bale to four acres. We have a sample of a cotton-plant in our exhibit at Atlanta which good judges estimate, if the acre could produce over its whole surface plants equal to the one we have, it would yield two bales and a half to the acre. If it is possible to grow that amount with extra cultivation, I

[redacted] Mr. Barrow. What is now ordinary would then be waste.

Mr. Woodbury. What is the difference between the actual value of cotton ginned on the saw-gin and cotton ginned on the roller-gin?

Mr. Barrow. We tried that experiment too, and found in Sea-Island cotton the waste was more than twenty-five per cent. We took some cotton pulled in the morning, — Jones's improved Orinoco, from which Mr. Atkinson's suit is made, — and ginned some of it on the best saw-gin that was in the Exhibition, and ginned another equal quantity on the roller-gin, and called in the cotton-factors to put a value on it. They classed the roller-gin cotton two grades below the saw-gin cotton; and we called in Mr. Garsed, and he pulled the staple, and classed the roller-gin cotton as two grades above the saw-gin cotton. That is a fair idea of the value of their judgment. I think any of you gentlemen who look at the samples here will see the difference; and, if you bought cotton in the same manner as they sell it down there, you would give more for the saw-ginned cotton than you would for the roller-ginned cotton. It is brighter and lighter. The light strikes on the fibres in a different way, and usually the cotton has the appearance of being whiter; whereas you take the roller-ginned cotton, and put it through the picker, and you cannot tell the difference.

MR. ATKINSON. Did you try the relative strength of the yarn?

Mr. BARROWS. We have not got to that yet. Another question is, whether cotton is injured by compression. We purchase it now in bags. A big darkey gets inside with an iron pestle, and pounds it down. The bags are about seven feet long and two and a half feet in diameter, and will hold 325 to 375 pounds of cotton. Of course our freight is very high, — $2.50 for a bag from Charleston. The Dederick press, which was run for the representatives of this Association, under charge of Mr. Dederick, was offered to try the experiment with Sea-Island cotton, if I would furnish the cotton. I did so; and, although I have not the report in detail, our people say it works just as well and makes as little waste as any cotton we ever had. The only care to be exercised is, that the cotton shall be taken out of the sack, and lightly thrown upon the floor, and, as it were, air-slacked. The simple fact of compression cannot, in my judgment, injure the fibre. If it did, we would ruin it all through our machinery.

I would like to say one other thing, which will be of interest to the Association, and that is, there has been a good deal of discussion about drawing-frames and excessive drawing. Every one knows that the Willimantic Company is an illustration of an immense number of doublings. When we made this suit of clothes the time was rather limited; and we put the cotton through the Kitson picker, and then made it into laps, and put two laps into one, put a lap into the Foss & Pevey card, and run two cards into a sliver, and set the railway-can up to the slubber, single; took the slubber-bobbin, and put in on the ring-frame, and made the yarn; so that we had four doublings. I have some of the yarn here. I would like to have it looked at. It is about No. 8, and we think it is about as good as any.

Mr. NATHANIEL HILL of Lowell, Mass., then next addressed the Association upon METHODS OF TRANSMITTING POWER BY BELTS WHEN THE AXES OF THE CONNECTED SHAFTS ARE NOT-PARALLEL. Mr. Hill illustrated his remarks by continuous reference to an elaborate series of working-models of pulleys furnished with paper belts. The report of his address appears with illustrative diagrams at the close of this discussion.

The Association then resumed the hearing reports from the Atlanta Exposition, and Mr. ATKINSON said, —

I shall add but a very few words more, referring you to the report in which I have included some statements that I will not take your time in submitting now, and then give way to others, who, I hope, will add something to what I say. Those who go to Atlanta will find intelligent and active planters who will be prepared to contract with them for special kinds of cotton to be picked with their own hands in such bale form which the sample will be drawn, and which they will guarantee. James H. Fanin is one of that class of men who would like to contract for two hundred bales of cotton next year, and there are many others. There is one mistake which we have all made. We have drawn our conclusions in regard to the general intellectual activity and intelligence of these Southern men who are engaged in farming from the ludicrous condition in which we have received the bales. No inference can be more false. My idea is, there is more intellectual development and business improvement to be seen in the immediate future on the part of those Southern planters and farmers than there is in respect to the men now engaged in the North and West. They are uninformed rather than ignorant, — uninformed as to mechanics and as to what is required; but there is the greatest possible eagerness to be informed as to what is wanted.

Reference has been made to experiments made by Mr. Dumont. Mr. Dumont it should be borne in mind, was a member of the Coast Survey. He knows what an observation is, and he knows how to observe. At my request, made to him several months ago, he tried the cotton in his mill in Gaston County, N.C., from the common bale and from the compressed bale. He made three separate series of trials of three series each, — nine trials in all. In each case there was less waste, and apparently better yarn, from the compressed bale than from the common bale, and from the common bale than from the cotton taken directly from the gin. It was a very startling conclusion to me. He is now arranging his small mill, in which there is a great deal of very excellent modern machinery, in which he shall be able to run 20's, one-half directly from the gin, and the other half from the compress. When we get that report, it will be something worth reading. If you reason upon this, it may become apparent that compression in the bale can do no harm compared to the compression which we give the cotton on our machines. Although the press may be very pow-

erful, the effect is diffused; while upon the drawing-frame and the roving-frame each fibre, almost, is subjected to compression between the rolls of a most injurious character.

You will find the utmost interest in Atlanta in inspecting the various machines for cleaning cotton-seed. Hullers are now being bought at Atlanta so fast that the makers will have difficulty in supplying their orders. The information that is being gained there can hardly be conceived at the present time.

The next point to which you must give your attention will be the crops of the small farmers. I have spoken of their intelligence. You have heard in the papers of Major Jones of Troup County, Ga. Major Jones followed the plantation system with sixteen mules, until he got seven thousand dollars in debt. He then changed his system, discharged his permanent hands, came down to two horses, and cultivates fifty acres or a little more of land. He calls his farm "Farm Independence." The reasons why he should do so are in this report which I herewith submit. He has paid his debt, and is now forehanded.

HOGANSVILLE, TROUP COUNTY, GA., Nov. 23, 1881.

EDWARD ATKINSON, Esq., *Boston, Mass.*

Dear Sir, — As I promised you, please find enclosed statement of my crop, expenses, etc., for 1880. I neglected to add to the sheet of expenses the cost of bagging and ties, which was $1.20 per bale, or $33.60.

In a few days I will forward you a statement of this crop (1881) as soon as I get through marketing my cotton.

You will see also that I state on sheet of income of crop that I used 650 bushels of cotton-seed as manure: I exchanged them, in other words, for the common variety of seed at one (1) bushel for from three (3) to five (5), but used only 650 bushels on the crop of 1880.

I have done the best I could, and hope you will be pleased.

Your humble servant,

JAS. F. JONES.

CROP OF 1880.

Based on 21 acres in cotton.
12 " " corn.
10 " " wheat.
14 " " oats.
1 " " sweet potatoes.
¼ " " rice.

With watermelon, chufa, and ground-pea patches, garden vegetables, such as cabbage, tomatoes, Irish potatoes, turnips, beans, pease, and all other garden products usually grown in this section.

In January and February, during such weather and at such times as ploughing could not be done free from freezing or wet, we cut and put forty cord of wood. Our compost heap was prepared also in such times and during rainy weather, as it was all under shelter.

Our wheat being sown, our first work on the farm was to sow oats: we had been three days seeding wheat, and now required about the same time to put in our oats. Our cotton-land, in connection with four acres of corn-land, also other preparations as were necessary for garden, sweet-potato patch, etc., were all finished up in good time, planting the four (4) acres of corn last of March, and cotton last of April; our manures having all been applied with distributor, and planter used in planting seeds. The remaining corn planted in June after oats, from same land, had been harvested (corn all on bottom or branch land).

By the time our small grain was ready for the scythe, our four acres in corn had been ploughed twice and hoed out; our cotton ploughed twice and hoed out nicely and clear of weeds; in accomplishing which, I used the $17 of extra labor, so as to be ready for my wheat and oat crop when it was ready to harvest.

Now, to get through with harvesting in time to get back to my corn and cotton before it would suffer for work, I employed extra labor: three cradlers and three binders finished the wheat and oats in a little less than two and one-half days, at $1.50 a cradle, they furnishing their own binders. The wheat cost $\frac{1}{10}$, and the oats $\frac{1}{12}$, for threshing. (I own an interest in a field-thresher, and did not pay toll.)

For this work I had three (3) extra hands at 75 cents per day, and in one day threshed out and housed all my grain, and penned the straw; then, up to saving my fodder and picking cotton, no extra labor was used; and, after finishing up the crop, set about repairing about my premises, such as renovating gates, moving rock for fencing purpose, clearing off ditches, etc., which time lasted about one month, from the 15th of July to the 15th of August; in the mean time finishing up the cultivation of our late corn planted after oats.

We commenced to pick cotton last of August; and, in order to gather it and our fodder, corn, pease, etc., as it ripened, employed extra labor to pick half the cotton, — fourteen (14) bales at $7 per bale, — when we ascertained, at the conclusion of our year's labor, that the results were as follows: —

28 bales cotton, average weight 518 pounds, at 10 cents	$1,448 00
300 bushels corn at $1.00 per bushel	300 00
190 bushels wheat at $1.25	237 50
500 bushels oats at $1 00	500 00
80 bushels sweet potatoes	25 00
16 bushels rough rice at $2 00	32 00
3,500 pounds fodder at $1.00 per hundred	35 00
3,000 pounds swamp-hay at $1 00 per hundred	30 00
12 bushels corn, field-pease, at $1.50	18 00
Wheat, oat-straw, and shucks, worth	50 00
40 cord wood at $1 50 per cord	60 00
850 bushels cotton-seed, and from their extra quality I sold 200 bushels for	600 00
The remaining 650 bushels I used as manure and to plant, 20 cents per bushel	130 00
We fattened and sold five (5) beeves of our own raising, 1 and 2 years old, for	40 00
We raised, fattened, and killed nine (9) pork-hogs at 7 cents per pound	125 00
	$3,630 50

EXPENSES AS LABORERS.

Willie Jones, 16 years old, board and	$75 00
Hugh Jones, 12 years old, board and	40 00
Gordon Jones, 9 years old, board and	40 00
Extra labor in cultivating	17 00
Seed-wheat, 10 bushels, worth	12 00
Harvesting wheat, oats, and threshing, extra labor	13 50
Seed-oats, 30 bushels	30 00
Rails made and put up, 2,000 at 50 cents per hundred	10 00
300 feet lumber used on farm	3 00
Nails, 25 pounds	75
Blacksmithing, iron, etc.	15 00
Picking cotton, extra labor	98 00
One and a half (1½) tons of guano	90 00
Cotton-seed used as manure	63 00
250 bushels corn consumed	250 00
1,000 pounds fodder	10 00
70 bushels oats	70 00
60 bushels wheat, as bread	75 00
1,200 pounds pork	84 00
Bagging and ties for cotton	33 60
	$1,029 85

N.B. — Ground-pease, chufas, turnips, Irish potatoes, and garden vegetables not marketable here at a fair valuation; no value can be estimated correctly.

N.B. — Not having room on sheet containing results of crops, I here state that we raised one fine colt also that year.

A discrepancy will be observed between the price at which cotton-seed is credited in the crop and charged in the cost.

This arises from the fact that Major Jones cultivates an extra staple, of which he sells the seed, and buys common seed for manure.

I may claim some satisfaction in this matter, as Major Jones has since written me that he adopted his present methods in consequence of reading my first pamphlet upon cotton, — a copy of which fell into his hands a few years since.

Now, gentlemen, that is in a county in which the average crop is not over a third of a bale to the acre, in a good climate, and where the water is good. There are fifty-eight thousand square miles in the State of Georgia; and seven thousand square miles, as well cultivated as Major Jones's farm, and as productive as his, would produce the entire cotton crop of the United States. The small farmer is ahead. It was interesting to notice the observations of intelligent planters from the Mississippi Valley who were there. They see that that is the competition they must meet, and that they must prepare their cotton to meet it. They are in a wholesome state of mind to be taught how to do this, in order to retain their hold on the crop.

In this connection it may be said that it was interesting, for one who was bred in the bone an abolitionist, to sit down over the lunch-table with the grandson of John C. Calhoun to compare notes about the ante-war period; to talk of that period as if there had been no animosity, no slavery, and no war; to have the grandson of John C. Calhoun say, that "if his grandfather had known as much about the negro as we know, and could have had the same confidence in his ability to sustain himself, and to place himself in a condition of comfort, which we have, there would neither have been slavery nor war." [Applause.] The response which is made to the strongest remark you can indulge in concerning slavery is very striking, — they respect you the more.

You will do well to observe the small rice-mills. An indefinite rice crop can be raised by the farmers the moment a machine is introduced that will properly clean the rough rice, and which will cost not to exceed one hundred dollars. The Carolina rice is nothing but a luxury; but upland rice, properly prepared, is a nutritious food.

There is a little apparatus outside which the turpentine men

say will entirely revolutionize the making of naval stores. Instead of getting the turpentine directly from the tree, they put the cord-wood right into the still, and bring out the tar and pyroligneous acid, and convert it entirely; so the original methods will be done away with. In fact, there is the beginning of more changes in that Exposition than ever happened in respect to any other exhibition in the world, because the opportunity for change is so vast and so great. If you choose to go up among the mountains, among the homespunners, you can study the whole history of any of the mechanic arts for the last century and a half in a week's journey. You can begin at the beginning of almost every art, and trace it down as you come out from those mountains, among a people who have never seen a wheeled vehicle. If you choose to go so far, you can trace every one of the arts, down to the present day, in a seven days' journey. I will only repeat one suggestive remark which was made to me by Col. Killibrew of Tennessee, when, looking over the marvellous collection of ores, minerals, and timber, I suggested that there will be ten customers to the North for one competitor. Col. Killibrew said, "Yes, Mr. Atkinson; but make one statement to your friends in the North, that there are two classes of persons we will not permit to come into this country and develop these resources." I did not know exactly what was coming, and I asked him to define the two classes; and he said, "Mormons and secessionists." [Laughter and applause.] They have had some trouble with the Mormons lately, and have had to make that classification.

I now move the following vote, sir: Voted, that Messrs. John Kilburn, B. F. Nourse, W. E. Barrows, George W. Weeks, John Scott, with such other members of this Association as they may join with themselves, constitute a committee to attend the Atlanta Cotton Exposition Dec. 6, to co-operate with the National Cotton Planters' Association in promoting the general interests of the cotton-growers and cotton-spinners of the country. Also, that this committee secure the attendance at said meeting of as many other persons who are interested in the manufacture of cotton as may be possible, whether members of this Association or not.

The motion was seconded by Mr. Draper.

Mr. ATKINSON. I trust that out of that joint meeting will come some action in respect to another suggestion that I made

to grow out of these things, — something definite. I wish there might be a committee of this Association who should make a few simple rules that they all agree to, that should be printed in black and white, and scattered like the leaves of the forest, if you please, among these people, stating just what you want on the part of the cotton-planters. You could adopt such rules as this: "Be sure you do not mix long-staple cotton with short;" and a few other simple rules. If you should spread them there, it would be a capital thing, in my judgment.

Mr. GARSED. It will all follow, if the gentlemen go to Atlanta and meet the planters. I have no doubt these things will come out as you expect them to.

Mr. Granville Nicholson of 71 John Street, New York, was granted the floor for the purpose of calling attention to his steel-wire cotton-ties; and he said, —

Cotton-ties are now made of iron hoops, and their weight on each bale is about ten pounds, which amounts to 31,500 tons on the cotton crop of last year. Now a steel-wire tie is made; and the weight of those ties would have been only 12,375 tons, a saving of 19,125 tons. The exporter and consumer of cotton buys those ties, and pays for them as cotton, at ten or eleven cents a pound. The saving would have been, if wire ties were used, about $4,000,000 on the crop of last year. It is a question for the manufacturers of cotton of New England whether this tie, or any other tie that can weigh eleven ounces, should be used. It is just as strong, perhaps stronger, and is as cheap, weighing only one-third as much, as the iron hoops. It is a very important question for those who are buying cotton and paying ten cents a pound for iron, when you can use a tie that only weighs one-third as much. I am speaking now of any light tie. This is the one I manufacture. If the cotton exchanges or cotton manufacturers of the country should say to the planter that he must not use a tie that weighs substantially over twelve ounces instead of one which weighs a pound and twelve ounces, a great saving could be made. My tie weighs eleven ounces, and is made of No. 9 Bessamer steel wire, and can be re-used, and for baling other things.

Mr. GOULDING. I rise, Mr. Chairman, to move that this Association tender a vote of thanks to Mr. Hill for his address and explanation of his models.

The motion was seconded and adopted.

[illegible] as a matter of curiosity, gentlemen before [illegible] several homespun articles spun [illegible]. Here is a homespun [illegible] embroidered with yarn spun by [illegible] of Georgia, who was [illegible] a poor Georgia "Cracker," [illegible] given to me by the [illegible] Sewing-Machine Company, is [illegible] of machinery which is [illegible]. I also call your attention [illegible] highly artistic embroidery [illegible] was in charge of the Wheeler & [illegible]. One was copied literally [illegible] for a copy, the colors [illegible] being exactly reproduced, [illegible] it. It was all done [illegible] think it is a work of art.

[illegible] testimony to this fact,— [illegible] connected with manufacturing [illegible] bound to learn every thing [illegible], or any thing that they [illegible]. They seem like new converts, so to speak. They [illegible], and they are talking about [illegible] remember what I say, that [illegible].

[illegible] number of articles in the [illegible] governor of Georgia and our [illegible] the pleasure of wearing suits of [illegible] which they had picked [illegible] manufacturer for several [illegible] to know how this could be done; [illegible] through many different processes to be [illegible] cut, and made up, [illegible] evening. Now, if all this is true, there is yet considerable for us to learn in regard to taking cotton and putting it into cloth. I should like to hear from Mr. Atkinson on the subject. [Applause.]

Mr. ATKINSON. There are two or three little inaccuracies in the statement that has been made about these suits of clothes. I will go back a little in my statement. The suits which were made for the governors before I got there were made in this

way: The cotton was gathered early in the morning for the filling. The warp is in the loom, the same as a satinet warp. The warp is not made at the same time. The warp being in the loom, the cotton was gathered in the early morning, dried off sufficiently to be ginned on the roller-gin by eight o'clock, spun upon the small spinning-frame, with four doublings, as has been stated by Col. Barrows, woven upon a Crompton loom, and, I think, by twelve o'clock the goods went to the dye-works of Mr. Thomas, outside, where they were dyed, and were brought back by two or three o'clock in the afternoon, the measure having been taken by Mr. Goss, the tailor, during the morning. The cloth was then cut, and the sewing done upon the Wheeler & Wilson sewing-machine. The garments were ready for wear by half-past six o'clock in the evening. The only difference in respect to my own suit is this, that, on the morning on which Mr. Garsed and myself and one of the governors were to have gone out in the field, it was raining so hard that we could not have picked the cotton; and therefore a portion of the previous lot was used for this coat and vest which I have on. This suit, which was made in that way, from the ginned cotton gathered on a previous day, early in the morning, starting at eight o'clock on the gin, was sent to Mr. Kimball's house at half-past six in the evening. I changed my dress, and walked over to the house occupied by Col. Barrows, and made a call upon him, with it on my back. It will be obvious, however, to you, that, if he chose to put the number of hands to do the work, and had a warper there, he could put a double and twist warp, which would not require another sizing, into that loom, and make a jean, with a warp and filling like this, in a day; and, if you stump him to do it, I am not sure he would not do it: but the warp is not made on the same day, — the rest is all made on the same day.

Mr. Atkinson alluded to the growing importance of the smal farmers of the South, by means of whose industry and intelligence the cost of raising cotton is being reduced, and said, that while no improvements can be made in removing cotton across the ocean, science having exhausted all its resources in this direction, they were also exhausting science in getting freight brought from the South to the North; but we are getting every year into a better and better position for its working up: and if my principle is rightly stated, that the

place where the wages are the highest is the place where the goods are made the cheapest. then you have field enough before you for the rest of your lives.

Mr. SMITH. I witnessed the operations of the Dederick cotton-press. while I was down at Atlanta; and I should like to offer this resolution, —

Resolved, That the attention of the Committee be called to the merits of the Dederick press, and that they report to this Association the results of their investigation.

The resolution was adopted.

The meeting then adjourned.

METHODS

OF TRANSMITTING POWER BY BELTS WHEN THE AXES OF THE CONNECTING SHAFTS ARE NOT PARALLEL.

By NATHANIEL HILL, Esq., Lowell, Mass.

ILLUSTRATED.

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You have, sometimes, occasion to connect shafts which are not parallel, by means of a belt. When there is considerable difference of height, and little power to be transmitted, you make use of a belt without guides, with the pulleys so placed that the belt will keep on the pulleys when running in one direction, as in this model (Fig. 4), where the belt remains on the pulleys at whatever angle I turn this upper pulley; *the belt drawing on to each pulley from a point in the plane of that pulley.*

But there is always a side or tearing strain on both the tight and slack sides of the belt, at the points where it leaves the pulleys (A, A′, Fig. 4); and, if the motion is reversed, the belt at once "runs off," as it no longer draws from a point in the plane of the pulley. When a heavy power is to be transmitted, this tearing strain is objectionable; and you then resort to the device of arranging the pulleys so that the belt shall draw with an even strain on both edges, from the driven-pulley to the driver on the tight side, leading the belt back to the driven-pulley by means of guide-pulleys more or less perfectly arranged. Here (Fig. 10) is a model of an arrangement that has been in use many years, I have been told, at the arsenal at Springfield and at other places. A pulley on each shaft, F, F′, may be taken for the working-pulleys, the two others being guides. Of course, it would not be advisable to have the guides, turning, as they do, in a reverse direction, run on the shafts of the working-pulleys; but they may be placed in the line of their present places, either beyond, or between the shafts. This arrangement is somewhat cumber

[illegible] The belt, however, runs perfectly [illegible] for the reason, that the two portions of belt, [illegible] each of the four pulleys, lie in the plane of that [illegible] belt moves, with reference to each pulley, from a [illegible] that pulley when moving in either direction. [illegible] obtained in other arrangements. This model [illegible] the same plane, the face of one, in a verti- [illegible] below the face of one working-pulley; the face [illegible] vertical line with, and over the face of the other [illegible] moving direct from one working-pulley to [illegible] This arrangement permits the guides to [illegible] as in the last model (Fig. 10), and, [illegible] the shafts of working-pulleys, can [illegible] distance between the working-pulleys [illegible] in the belt; as there is always room [illegible] working-pulleys and guides. The [illegible] arrangement to get the belt being looped [illegible] or merely deflected by each [illegible] belt is tightened by vertical adjust- [illegible] as shown

[illegible] the same perfect manner by means [illegible] pulleys in the same plane (Fig. [illegible] portion of belt near each working- [illegible] toward the right side of the [illegible] used as tighteners [illegible] extending from the [illegible] guides [illegible] between the guides. [illegible] the belt Fig. 5). [illegible] guides. This arrange- [illegible] distance between [illegible] a strip between [illegible] guides in all [illegible] difficulty, may [illegible] for the belt, so [illegible] working pulley lies [illegible] the plane of [illegible] is deflected [illegible] guides before the [illegible] be determined [illegible] the two pulleys, or, [illegible] exact [illegible]

When the shafts to be connected are at nearly the same height, we must always use a guide on the tight side of the belt. This arrangement (Fig. 11, which is the same model as Fig. 10, opened out) shows the ordinary overhead quarter-turn belt, arranged for working-pulleys of same size, and at the same height. In this case the guides may be placed on a vertical shaft, and the belt will run in either direction perfectly. The guides cannot, however, be used as tighteners, and the position is not a desirable one in which to run a very heavy belt. For all other cases than that of equal speed and equal height of shafts, the position of the guides, to admit of perfect running, must be determined by means of the cord, or by drawings, as explained.

The arrangement now shown (Fig. 12) is copied from a sketch furnished me, of a belt now running, in which the two guides are on horizontal shafts, and are at about the same height; it will admit of a change of speed between the two working-shafts, which may also differ in height. The belt will run only in one direction, and has the defect of a side strain on both the tight and slack sides; while here (Fig. 13) is a model similar in arrangement, in which the belt will run in either direction, and, of course, without the side strain in the belt.

Nearly two years ago I was called upon to arrange a belt, to connect shafts at nearly the same height, in the mills of the Appleton Company at Lowell. The agent preferred to use a looped belt rather than an open belt to a shaft in another story, and from there return with a quarter-turn belt with guides, as he could thus accomplish the result by the use of four pulleys and one belt, while the other arrangement involved the use of six pulleys and two belts. I proposed the arrangement here shown (Fig. 6), which has guides on horizontal shafts. A portion of the power may be taken off on one of the guides, thus delivering power to two stories at right angles to the driving-shaft; and the other guide may be used as a tightener. It was found that a floor-beam (T, Fig. 15), shown here in a model made to scale, interfered with the passage of the belt from one pulley to the guide: to avoid this, I proposed to use a smaller guide (N, Fig. 15), and so set, that the belt should run correctly in either direction. Fig. 9 is the same arrangement, but of different proportions, to show more plainly the canted guide. I determined the position of the guide by calculation; and, when a trial belt was put on, it was found to run perfectly in either direction. It was designed to transmit 120 horse-power with an eleven-inch double belt, running about 5,200 feet per minute. It is believed that it was used to transmit 150 horse-power, always giving satisfaction, and is now to be replaced by an arrangement to transmit a much greater amount of power.

Fig. 8 shows an arrangement often used in woollen-mills, where the guides are called carrier pulleys, or, sometimes, gallows pulleys. The guides are ordinarily set at the same height, an arrangement that can never admit of a perfect running belt; although it will answer a purpose, when little power is to be transmitted. Mr. Sellers of Philadelphia has, I think, a hanger for the guides, that is applicable for one position of the driven-pulley in reference to the driver. For all other cases the position must be determined specially, by lines or drawings, as before stated, if it is important to have a perfect running belt.

The next model (Fig. 14) shows two pulleys which are not in line, are not of same size, are not square with each other. One shaft is not horizontal, and differs in height from the other, and the belt is crossed; thus presenting, I think, all the difficulties usually met with: yet the belt runs perfectly in either direction by means of two guides.

Referring again to the case of shafts at angles, having considerable difference in height. Here is a model (Fig. 19) with a cord stretched over the working-pulleys, and the ends brought together in a point of the cord between the two working-pulleys, so that the portions of cord about each pulley are in the plane of that pulley: a guide-pulley, to run perfectly, must lie in the plane of, and touch, the two end portions of cord thus placed.

It is not uncommon practice to place guides on the slack side, in positions having a resemblance to those here shown (Figs. 1 and 5), but with this important difference, that the belt draws at one edge, having the same fault as the quarter-turn without guides (Fig. 4), except that the defect is transferred wholly to the slack side of belt.

There have been in use two different schemes to guide the belt in this defective way: one leads the belt off to one side from the driving-pulley on to a guide which is at first set on a horizontal shaft, with one of its faces in the plane of the driven-pulley, and then direct on to the driven-pulley; the guide is then canted by trial until it will retain the belt. A guide so placed is in a very different position from that shown in Fig. 1, and requires constant changes in position to keep the belt in place with varying loads, and at once runs off if the motion is reversed. If two guides are used, the second (H, Fig. 16) is placed in the plane of the driven-pulley with a face in a vertical line with the face of the first guide as set before being canted. When the two guides are properly arranged in this scheme, the belt draws properly over both guides, and has a tearing strain only at the point (K, Fig. 16) where it leaves the driving-pulley. The guide in the plane of the driven-pulley can be used as a tightener, by vertical adjustment. This arrangement will run only in one direction, and, at best, gives only partial satisfaction.

In the second scheme (Fig. 17), when a single guide is used, it is set in a plane passing through the portion of belt leading from the driving-pulley, with its shaft in a vertical plane parallel to that portion of the belt. The guide-pulley is set so as to deliver the belt in the plane of the driven-pulley, but the pulley itself is not set in the plane of the two straight portions of belt in contact with it: there is, therefore, a side strain on the belt at the point (L) where it leaves the guide. In short, this scheme to use a single guide, like the last named, will not work as laid out; and its position is varied by trial until the belt will retain its place for a time. When two guides are used, the second is placed in the plane of the driving-pulley, and near to it, bringing the belt near to its tight side. The canted guide is placed between that guide-pulley and the driven-pulley as before (Fig. 18). With two guides there is less cant in the first guide; and the fault of side draught is lessened, but can never be fully corrected. If a wedge were placed on a vertical surface parallel to the driven-pulley, to give the necessary cant to a stud carrying the guide, the thin edge of the wedge (M, Figs. 17, 18) would be, by this arrangement, horizontal; while, when the guide is correctly placed (as in Fig. 1 or Fig. 19), the thin edge would be parallel to the portion of belt between the guide and driven pulley. The wedge itself would be of a different angle from that used in the imperfect scheme mentioned. The correct construction would bring the thin edge of the wedge horizontal only when the top of the guide is at the same height as the bottom of the driven-pulley, — a position impossible to attain in practice. The better way is, to select a point near each working-pulley, in the plane of that pulley, and at a safe distance from the tight side of the belt, and trace out this path with a cord; then, as before explained, put the guides in the plane of the adjoining portions of the cord. Fig. 5 is an example of this practice.

It may, or may not, be important to run the belt at any time in a reverse direction; but the fact, that the belt can so run, is proof that the belt is drawing evenly at each edge; and that the whole capacity of the belt can be used in transmitting power, beside reducing the extent and inequality of stretching. The fault of side strain is very different from the stretch due to twisting a belt about its centre: the one is excessive, and at one point of the belt; the other is slight, and distributed, and need never be as great as the stretch of the outside of a belt more than that of its centre, when wrapping round a pulley of ordinary size. This never gives concern, and is hardly recognized as existing. The fault due to twisting never occurs at the same time as that due to wrapping; and as it is, or may be, less in amount, it will be covered by the last-named fault.

A preference is often expressed for the arrangement shown in this

model (Fig. 5), on account of the extent to which the belt wraps the working-pulleys: the value of wrap, in increasing the adhesion of the belt, is, perhaps, not generally understood. I have a chart, or diagram (Fig. 20), calculated from the formula generally accepted, for each ten degrees, with a curve drawn through the points thus laid down. The dark band represents the width of belt required to transmit the strain of the load, — that is, the width of belt that would be required if the adhesion of belt to pulley were perfect: the lighter portion outside shows, by radial measurement, the proportionate width required to carry the strain needed on the slack side, to maintain sufficient adhesion; while the dark and light portions together, measured radially, show the proportionate width of belt needed to transmit the power, with a given amount of wrap, and maintain the needed adhesion. When the index at the number 180, of the inner circle, is turned to the radial line marked 1.36, the diagram is adapted for that co-efficient, or factor, for friction between iron and leather, which is generally accepted for the case of pulleys of fair size, with belts in good condition. Opposite the mark of inner circle indicating 260 degrees, we find the number 1.17, which indicates that the proportionate width of belt required at 260 degrees is $\frac{117}{136}$ of that required at 180; or, about as 6 to 7. The points to set the index or 180 degree mark, for other factors for friction, are placed on the dark band; and, if I set it at the number 70 (indicating seventy per cent of friction between the belt and pulley, which may be assumed in the case of a leather-covered pulley, and a belt in good condition), we shall now find that the mark indicating 260 degrees of wrap is beyond the point to which I have carried the curve; but it will be seen that the radial lines are growing shorter very slowly, and, at the point opposite the mark for 260 degrees, would be about 1.06; while at 180 degrees the width is about 1.12, — that is to say, at 260 degrees of wrap a seventeen-inch belt might be used in place of an eighteen-inch belt at 180 degrees. This slight advantage in increased wrap is more than offset by the increased strain needed, on the slack side, to keep the belt on the guide-pulleys when the guides are incorrectly set, as in Figs. 16, 18.

It is generally assumed, that, for ordinary cases, an inch, in width, of double belt will transmit one horse-power, when the belt is running on iron pulleys at the rate of 400 feet per minute; and I know of no cases of failure to do good work, when that proportion has been adopted. If we calculate the necessary width of belt for any required power on this basis, and assume that, as proper for 180 degrees of wrap, then on setting the index for another factor for friction, we can read off the figures for any degree of wrap, and compare with the figures 1.36; thus determining the proportionate width of belt for

the particular case. If a belt running at 4,000 feet per minute were required to deliver 120 horse-power, a twelve-inch belt would be needed; now, if we make use of a leather-covered pulley by which we could increase the factor for friction to 70, we should have for, let us assume, 150 degrees of wrap, a required width of belt $1.16 \div 1.36 \times 12$, or about $10\frac{1}{4}$ inches. It is not proposed to calculate to quarter-inches on belting, while there is such a variance in opinion as to the proper width of belt needed for ordinary cases, nor until belts from different manufacturers become more nearly equal in strength.

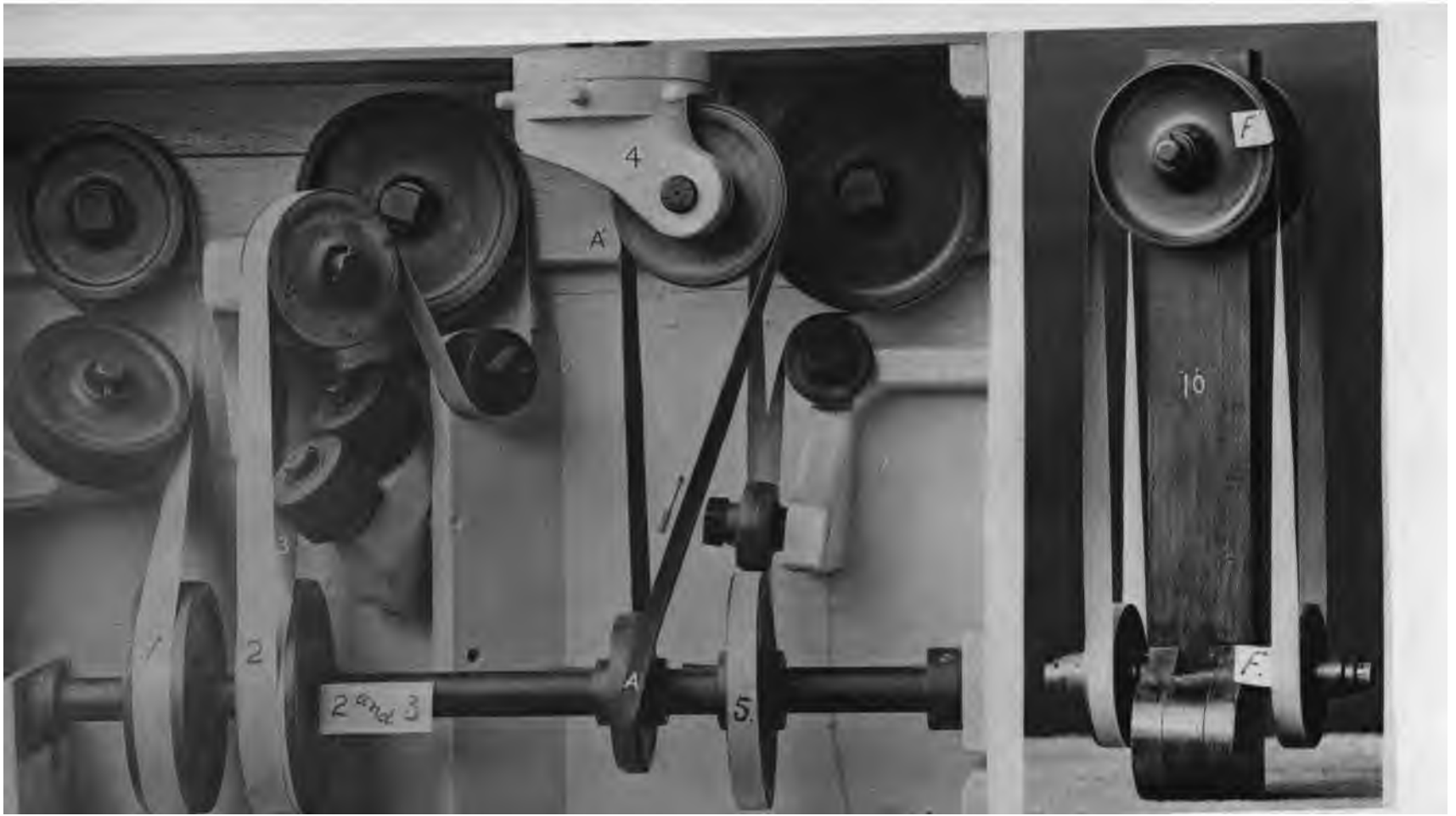
The diagram illustrates, however, the proportionate widths required for different degrees of wrap, and different factors for friction; and, if you can determine what is satisfactory for one case, you may, from the diagram, determine what would be equally satisfactory for another, with a belt having the same strength for an equal section. The diagram presents all the results of somewhat tedious calculations, with more than sufficient precision.

NOTES. — If the circle inside the dark band of diagram (Fig. 20) is cut out with a sharp knife, it may then be turned as stated; and if the two portions are mounted on cardboard, and the circle made to turn on a pin, the diagram will be reproduced as exhibited.

Reference having been made, at the meeting, to "a system analogous to" mine, in use at the Allison Car Works, Philadelphia, I wrote to Mr. Allison; and, after sending him drawings of five arrangements, he selected that representing Fig. 6, as being like his, — which has been running about ten years, with a twenty-inch belt. This was unexpected evidence of the practicability of the arrangement, and is offered for the use of those needing that evidence more than I do.

Examples of the second-named imperfect scheme for quarter-turn belt with guides, having one pulley on horizontal shaft, and one, on canted shaft (Figs. 17, 18), may be seen in models at Lowell Machine Shop, also one, arranged for single guide, in actual operation. The agent will undoubtedly bear testimony to the defects of angle belts, based on his practical experience with them.

Examples of the first-named imperfect scheme for quarter-turn belts with guides, being that with guides on horizontal shafts (Fig. 16), in various degrees of perfection, may be seen in a number of the mills at Lowell; and a drawing of one case, made by an eminent mechanical engineer, was in existence not long since, at the office of one of the mills there, which well illustrates the state of the art.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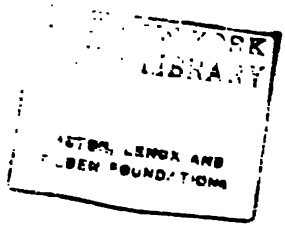
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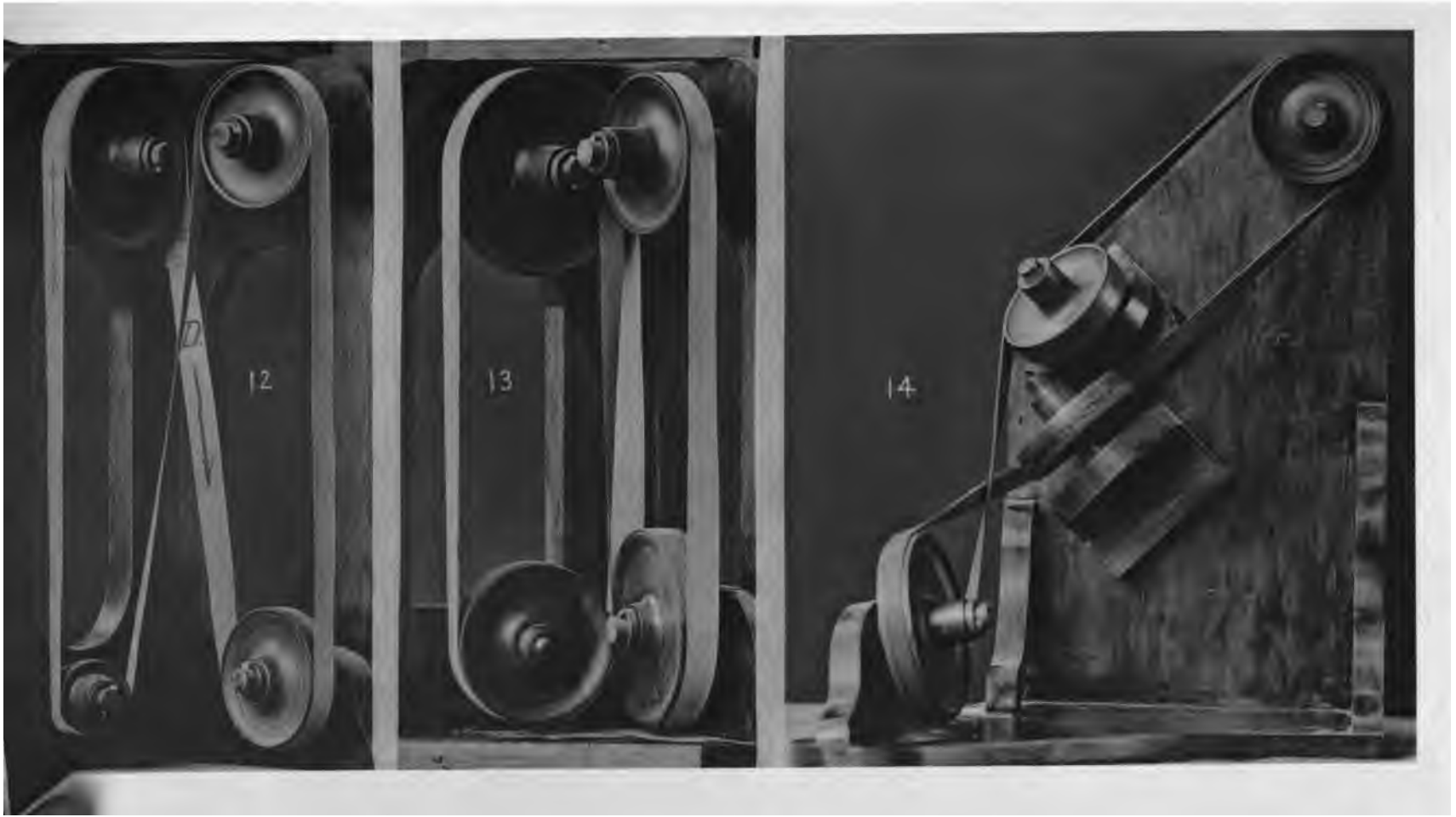
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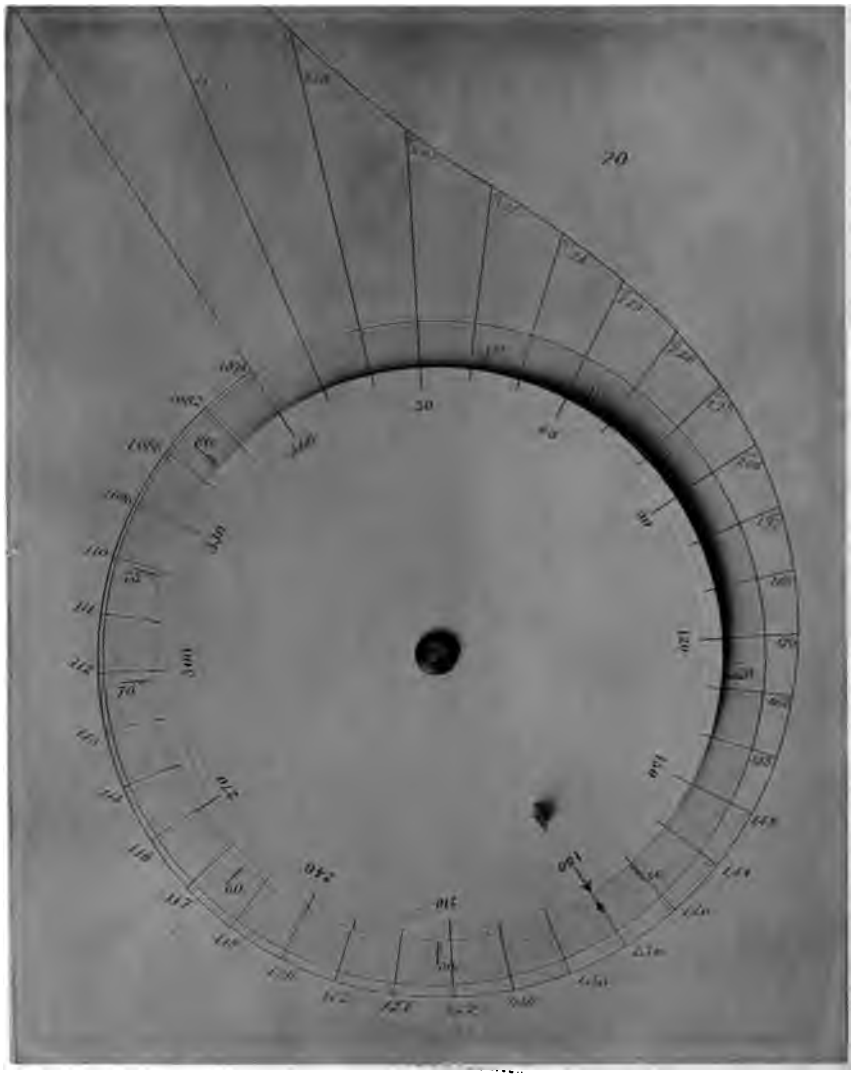

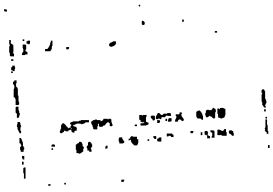

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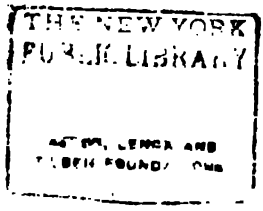
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[No. 32.]

N. E. COTTON MANUFACTURERS' ASSOCIATION.

PROCEEDINGS

OF THE

SEVENTEENTH ANNUAL MEETING,

HELD AT BOSTON APRIL 26, 1882.

PRECEDED BY

CONSTITUTION AND CATALOGUE OF MEMBERS.

BOSTON:
FRANKLIN PRESS: RAND, AVERY, AND COMPANY,
117 FRANKLIN STREET.
1882.

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION.

CONSTITUTION.

PREAMBLE.

THE undersigned, Agents and Managers of Cotton Mills in New England, desirous of promoting a more intimate acquaintance with each other, and of collecting and imparting information as to the best methods of manufacturing Cotton, hereby form themselves into an Association, by the name of the New England Cotton Manufacturers' Association, and adopt the following By-Laws for its government; pledging themselves, each to the other, to abide by the same until altered or repealed.

BY-LAWS.

ARTICLE 1. The officers of this Association shall be a President, two Vice-Presidents, six Directors, a Treasurer, Secretary, and Auditor of Accounts.

ART. 2. There shall be a meeting of the members of the Association, annually, on the last Wednesday of April, in Boston, or at such other time, and at such hour and place, as the Board of Government may determine. At the first meeting of the Association, for organization, and thence afterward at each annual meeting, a President, two Vice-Presidents, and six Directors shall be chosen by ballot. The President, or in his absence the senior Vice-President, shall preside at all meetings of the Association and of the Board of Government. The officers chosen at the first meeting shall hold their offices until the next annual meeting, and until others shall be chosen in their stead. There shall also be a semi-annual meeting of the Association on the last Wednesday of October, in each and every year, or at such other time, and at such place and hour, as the Board of Government may appoint. Special meetings may be called by the Board of Government whenever they may deem it expedient, or upon the written application of any ten members made to the Secretary: provided notice is given to the members as in other meetings.

ART. 3. All meetings of the members of the Association shall be in pursuance of a written or printed notice, addressed to each member, with the name of the President or Secretary attached thereto, and deposited in the Post Office ten days at least before the day of meeting, specifying the time and place of meeting; and at all such meetings fifteen members shall constitute a quorum for the transaction of business.

ART. 4. The President, Vice-President, and Directors shall constitute a Board of Government, and have under their care and direction all matters pertaining to the management of the Association; and five of their number shall constitute a quorum for the transaction of business. Meetings of the Board may be called by the President, at such time and place as he may deem expedient, giving each member a written or printed notice of the same at least five days before the day of meeting. At their first meeting the Board shall elect a Treasurer, Secretary, and Auditor of Accounts, for the year ensuing, and fix the amount of compensation of the Secretary. All vacancies in their Board, occasioned by death or resignation, shall be filled by the Board; and the persons so elected shall hold their offices until the next annual meeting. The Board may, from time to time, as they shall deem expedient, appoint Committees, from among their own Board or from the members at large, to collect statistical information, examine new inventions or processes in manufacturing goods, as also to prepare essays on subjects of interest to the Association.

ART. 5. The Secretary shall attend all meetings of the Association and of the Board of Government, keep accurate records of their doings, and prepare a book into which he shall transcribe the By-Laws, and procure the signatures of members to the same. In the absence of the Secretary at any meeting, a Secretary *pro tem.* may be appointed by the presiding officer, who shall do all things, while in office, required of the Secretary.

ART. 6. The Treasurer shall keep a book in which all receipts and payments of money shall be entered, collect all moneys due the Association, and disburse the same upon the written order of the Board of Government. At the annual meeting in each year he shall make an exhibit of his accounts, or oftener if the Board of Government require it. He shall notify the members of assessments voted, and cause them to be collected in a reasonable time.

ART. 7. The Auditor shall examine the accounts of the Treasurer annually, and report at each annual meeting the state of the finances.

ART. 8. All nominations for membership shall be made in writing, at least one week before the date of any regular meeting, and shall be considered by the Board of Government, and reported to the meeting, favorably or adversely, for the action of the Association: provided, that in case the Board shall decide to report adversely upon any nomination, the member who shall have made it shall be informed of the intention so to report, in order that he may have an opportunity to withdraw the name. Upon such report, new members may be admitted, if they obtain a majority of votes of the members present, upon signing the By-Laws, and paying an admission-fee of ten dollars and an annual assessment not exceeding ten dollars. Any member may withdraw from the Association at any regular meeting, upon payment of all arrearages, first giving notice of his intention so to do

to the Secretary; and any member may be expelled *for cause* at any regular meeting, two-thirds of the members present voting therefor.

ART 9. It shall be the duty of all members of the Association to make returns to the Secretary of such statistics as may be called for by him, under the direction of any Committee duly appointed for the collection of statistics, when not incompatible with private interests.

ART. 10. Honorary members may be elected, when recommended by the Board of Government, at any regular meeting of the Association, who shall be enrolled as such, and shall be entitled to attend the meetings of the Association, and participate in its proceedings, without the right to vote. They shall not be subject to payment of admission fees or assessments. No person actively engaged in cotton manufacture in New England shall be eligible to honorary membership.

ART. 11. Amendments to the By-Laws may be made at any stated meeting of the Association, by a two-thirds vote: provided notice of such proposed amendment be given in writing at a previous meeting, and also notice be given to each member, by the Secretary, of the pendency of such amendment, ten days at least before any such meeting.

BOARD OF GOVERNMENT.

1882.

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RICHARD GARSED . . . . . PHILADELPHIA, PENN.

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SECRETARY AND TREASURER.

AMBROSE EASTMAN . . . . . BOSTON, MASS.

Office of the Association, Room 68, Sears Building, Boston.

MEMBERS OF THE ASSOCIATION.

1882.

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George Arms	New York City.
Benjamin F. Nourse	Boston, Mass.

ACTIVE MEMBERS.

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William Ames	Fletcher Manuf Co.	Providence, R I.
William Ames		Peterborough, N H.
James S. Amory	Lancaster Mills	Boston, Mass.
William Amory, jun.	Langdon Mills	Boston, Mass.
Edward Atkinson		Boston, Mass.
George Atkinson	Massachusetts Mills	Boston, Mass.
A. T. Atherton		Lowell, Mass.
Frank Atkin	Washington Mills	Lawrence, Mass.
J. S. Atwood	Wauregan Mills	Wauregan, Conn.
Edwin H. Baker	Otis Co	Ware, Mass.
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A. D. Barker	Warren Cotton Mills	West Warren, Mass.
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Stockton Bates	Bridesburg Manuf. Co.	Philadelphia, Penn.
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John Birkenhead		Mansfield, Mass.
N. B. Borden	Barnard Manuf. Co.	Fall River, Mass.
Richard B. Borden	Troy C. and W. Manuf. Co.	Fall River, Mass.
Thomas J. Borden	American Print Works	Fall River, Mass.
Thomas S Borden	Metacomet Mills	Fall River, Mass.
E S Boss	Willimantic Linen Co.	Willimantic, Conn.
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Erastus Boyden	Prescott Mills	Lowell, Mass.
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B. C. Brainard	Glasgow Co.	S. Hadley Falls, Ms.
Lucius Briggs	Grosvenor Dale Co.	Grosvenor Dale, Ct.

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William A. Burke		Lowell, Mass.
William D. Cadwell	Jackson Co.	Nashua, N.H.
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George A. Chace	Shove Mills	Fall River, Mass.
Jonathan Chace	Valley Falls Co.	Valley Falls, R.I.
Simeon B. Chase	Tecumseh Mills	Fall River, Mass.
Alfred D. Chandler	Ocean Mills	Newburyport, Mass.
Thomas C. Chandler,	Willimantic Linen Co.	Willimantic, Conn.
Alfred Clarke		Lowell, Mass.
F. E. Clarke	Pemberton Co.	Lawrence, Mass.
Jeremiah Clark		Lowell, Mass.
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Francis Cogin	Augusta Factory	Augusta, Ga.
P. J. Congdon	Providence Steam Mill	Providence, R.I.
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A. G. Cumnock	Boott Cotton Mills	Lowell, Mass.
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John Cumnock	Great Falls Manuf. Co.	Great Falls, N.H.
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John W. Danielson	Quinebaug Co.	Providence, R.I.
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B. D. Davol	Pocasset Manuf. Co.	Fall River, Mass.
James C. Davol	Middlebury Cotton Mills	Middlebury, Vt.
James Dempsey	Lewiston Bleachery	Lewiston, Me.
Frederic Dexter		Boston, Mass.
George Dexter	Pepperell & Laconia Cos.	Boston, Mass.
George Draper		Hopedale, Mass.
William F. Draper		Hopedale, Mass.
Joseph Dronsfield	Fletcher Manuf. Co.	Providence, R.I.
David H. Dyer	Quequechan Mills	Fall River, Mass.
William A. Eastman	Ocean Mills	Newburyport, Mass.
Charles L. Eaton		Providence, R.I.
Isaac Eaton		Nashua, N.H.
Herbert R. Farnum	Bernon Manuf. Co.	Georgiaville, R.I.
Herbert Fisher		Dedham, Mass.
M. F. Foster	Langley Manuf. Co.	Langley, S.C.
Philip H. Fowler	Gloucester Gingham Mills	Gloucester, N.J.
J. Dwight Francis	Pontoosuc Manuf. Co.	Pittsfield, Mass.

A J. Gardiner	Danielsonville Cotton Co.	Danielsonville, Ct.
James G. Garland		Biddeford, Me.
Richard Garsed	Wingohocking Mills	Philadelphia, Penn.
Charles J. Goodwin	Indian Orchard Mills	Indian Orchard, Ms.
W. F. Goulding	Androscoggin Mills	Lewiston, Me.
David Gowdey		Providence, R.I.
James Grant	137 Duane Street	New York City.
Benjamin Greene	Cabot Manuf. Co.	Brunswick, Me.
Frederick Grinnell		Providence, R.I.
Z. D. Hall		Lowell, Mass.
H. P. Hammett	Piedmont Manuf. Co.	Greenville, S.C.
J. F Hanson	Bibb Manuf. Co.	Macon, Ga.
C. M. Harris, jun.		Oakdale, Mass.
Thomas Haskell		W. Peterboro', N.H.
William Hayes	Barker Mill	Auburn, Me.
Jefferson Higgins	Slatersville Cotton Mills	Slatersville, R.I.
John H. Higgins	Forestdale Manuf. Co.	Slatersville, R I.
Charles L. Hildreth		Lowell, Mass.
J. G. Hill	Lawrence Manuf. Co.	Lowell, Mass.
J. P. Hillard		Fall River, Mass.
Reuben M. Hobbs	Montreal Cotton Co.	Valleyfield, P Q.
John Holland	Cocheco Manuf. Co.	Dover, N.H.
Stephen Holman		Holyoke, Mass.
George W Holt, jun.	Monohansett Manuf. Co.	Putnam, Conn.
Henry S Howe	Pepperell & Laconia Cos.	Biddeford, Me.
W. H. Jennings	Merchants' Manuf. Co.	Fall River, Mass.
D. L. Jewell	China, Webs'r, & Pemb'ke M.	Suncook, N.H.
D. W. Johnson	Monadnock Mills	Claremont, N.H.
D. J. Johnston	Harmony Mills	Cohoes, N.Y.
Russell L. Jones	Ascutney Mills	Windsor, Vt.
Royal Kalloch	Tennessee Manuf. Co.	Nashville, Tenn.
Thomas W. Kanada	Lewiston Mills	Lewiston, Me.
Roland R. Kelly	Beaver Mills	North Adams, Mass.
Joseph H. Kendrick		Providence, R.I.
Hervey Kent	Exeter Manuf. Co.	Exeter, N.H.
John Kilburn	Lawrence Manuf. Co.	Lowell, Mass.
E. C. Kilburn	King Philip Mills	Fall River, Mass.
H. C. Kimball	Blackstone Manuf. Co.	Blackstone, Mass.
Richard Kitson		Lowell, Mass.
Ira F. Lawry	Whittenton Manuf. Co.	Taunton, Mass.
Frederick A. Leigh		Boston, Mass.
Thomas J. Leiper	Irving & Leiper Manuf. Co.	Chester, Penn.
J. Ivers Lewis	Uncasville Manuf. Co.	New London, Conn.
William Lindsey	Weetamoe Mills	Fall River, Mass.
Charles W. Lippitt	Social Manuf. Co.	Providence, R.I.

Henry Lippitt . . .	Social Manuf. Co.	Providence, R.I.
Henry F Lippitt . .	Globe Mill	Woonsocket, R.I.
A. D. Lockwood . .	Lockwood Co.	Providence, R.I.
Robert W. Lord . .	. . . . .	Kennebunk, Me.
Charles L. Lovering .	Whittenton Manuf. Co. . .	Taunton, Mass.
Henry M. Lovering .	Whittenton Manuf. Co. . .	Taunton, Mass.
William C. Lovering,	Whittenton Manuf. Co. . .	Taunton, Mass.
Augustus Lowell . .	Boott Cotton Mills	Boston, Mass.
George M. Lowrie .	Clarendon Mills	W. Boylston, Mass.
J. S. Ludlam . . .	Merrimack Manuf. Co. . .	Lowell, Mass.
Rufus A. Maxfield .	Nashua Manuf. Co.	Nashua, N.H.
Thomas Mayor . .	. . . . .	Providence, R.I.
Robert McArthur .	Manchang Manuf. Co. . . .	Manchang, Mass.
Richard McCarthy .	Anniston Manuf. Co. . . .	Anniston, Ala.
W. E. McCoy . . .	Riverside Mills	Augusta, Ga.
James E. McCreery .	Granite Mills	Fall River, Mass.
Charles D. McDuffie .	Manchester Mills	Manchester, N.H.
James H. McMullan	. . . . .	Biddeford, Me.
Oliver H. Moulton .	Hamilton Manuf. Co. . . .	Lowell, Mass.
J. Turner Morehead	. . . . .	Leaksville, N.C.
W. H. Munroe . .	Bartlett Steam Mills . . .	Newburyport, Mass.
A. F. Nagle . . .	. . . . .	Providence, R.I.
Charles S. Nelson .	Victory Mills	Victoryville, N.Y.
John H. Nichols . .	Dwight Manuf. Co.	Boston, Mass.
Charles Nourse . .	Social Manuf. Co.	Woonsocket, R.I.
Franklin Nourse . .	York Manuf Co.	Saco, Me.
Carlos Nudd . . .	. . . . .	Providence, R.I.
J. Clark Nutting . .	Hooksett Manuf. Co. . . .	Hooksett, N H.
George H. Nye . .	Laurel Mills	Laurel, Md.
John C. Palfrey . .	Manchester Mills	Boston, Mass.
Francis J. Parker .	Monadnock Mills	Boston, Mass.
Walter E. Parker .	Pacific Mills	Lawrence, Mass.
John H. Parks . .	New Brunswick Cotton Mills,	St. John, N B.
Theo'lus Parsons, jun.	Lyman Mills	Holyoke, Mass
Charles S. Peach . .	Freeman Manuf. Co. . . .	No. Adams, Mass.
William D. Pennell .	Lincoln Mill	Lewiston, Me.
Haven C. Perham .	. . . . .	Lowell, Mass.
John M Pevey . .	. . . . .	Lowell, Mass.
Moses Pierce . . .	Norwich Bleachery	Norwich, Conn.
Thomas F. Plunkett.	Union Manuf. Co.	No. Manchester, Ct.
H. L. Pratt. . . .	Canada Cotton Manuf. Co. .	Cornwall, Ont.
Thomas Pray, jun. .	. . . . .	Boston, Mass.
J. E. Prest	Wampanoag Mills	Fall River, Mass.
J. M. Pusey . . .	Delaware Mills	Wilmington, Del.

T. G. Ramsdell	Monument Mills	Housatonic, Mass.
Robert Redford	Arlington Mills	Lawrence, Mass.
James Renfrew, jun.	Renfrew Manuf. Co.	Adams, Mass.
Roscoe C. Reynolds		Lewiston, Me.
John Rhodes		Millbury, Mass.
F. H. Rice		W. Boylston, Mass.
A. Robeson	Fall River Print Works	Brookline, Mass.
Charles E. Rogerson	Peabody Mills	Newburyport, Mass.
William F. Salmon	Lowell Hosiery Co.	Lowell, Mass.
H. Saltonstall	Chicopee Manuf. Co.	Boston, Mass.
Wm. G Saltonstall	York Manuf. Co.	Boston, Mass.
Eugene H. Sampson	Everett Mills	Boston, Mass.
A. H. Saunders		Nashua, N.H.
Benjamin Saunders	Harbor Manuf. Co.	Nashua, N.H.
J. H. Sawyer	95 Milk Street	Boston, Mass.
John Scott	Willimantic Linen Co.	Willimantic, Conn.
John C. Sharp, jun.	Canoe-River Mills	Taunton, Mass.
E. M. Shaw	Lisbon Manuf. Co.	Lisbon, Me.
Thomas S Shaw	Suffolk Mills	Lowell, Mass.
George E. Sherman	Peabody Mills	Newburyport, Mass.
Charles M. Shove	Granite Mills	Fall River, Mass.
George H. Simmons		Ansonia, Conn.
James B. Siner		Lawrence, Mass.
A. C. Slater	Linwood Mills	Whitinsville, Mass.
Robert R. Smith	Greenwoods Co.	New Hartford, Conn.
S. S. Spencer	Conestogo Steam Mills	Lancaster, Penn.
James C. Stanley	Greenwoods Co.	New Hartford, Conn.
Robert L. Steele	Great Falls Manuf. Co.	Rockingham, N.C.
Wilbur A. Stiles	Victoria Mills	Newburyport, Mass.
J. M. Stone		N. Andover, Mass.
Joseph Stone	Pacific Mills	Lawrence, Mass.
Royal O. Storrs		Dedham, Mass.
E. A. Straw	Amoskeag Manuf. Co.	Manchester, N.H.
Henry D. Sullivan	Naumkeag S. Cotton Co.	Salem, Mass.
Charles J. Sweet	Attawaugan Mill	Killingly, Conn.
George P. Taylor	Lancaster Mills	Clinton, Mass.
E. A. Thissell		Lowell, Mass.
Edwin R. Thomas	Clinton Manuf. Co.	Woonsocket, R.I.
Wm. H. Thompson	Lowell Felting Mills	Boston, Mass.
William E. Trainer	Linwood Mills	Linwood Sta., Penn.
Edmund E. Truesdell,	China, Webs'r & Pemb'ke M.	Suncook, N.H.
Albert F. Upton		Boston, Mass.
James Waring	Narragansett Mills	Fall River, Mass.
J. W. Wattles		Canton, Mass.

T. B. Wattles . . .	Chicopee Manuf. Co. . . .	Chicopee Falls, Ms.
John Webster . . .	Newmarket Manuf. Co. . .	Boston, Mass.
George W. Weeks .	Lancaster Mills	Clinton, Mass.
Francis M. Weld, jun.	China Mills	Boston, Mass.
Henry F. West . .	Washington Manuf. Co. . .	Gloucester, N.J.
Channing Whitaker .	Mass. Institute Technology .	Boston, Mass.
Nelson D. White . .	N. D. White's Mills . . .	Winchendon, Mass.
Wm. E. Whitehead .	. . . . .	Lowell, Mass.
W. J. Whitehead .	V. Hudon Cotton Manuf. Co.	Hochelaga, P.Q.
Charles E. Whitin .	Whitin Manuf. Co.	Whitinsville, Mass.
Charles P. Whitin .	Whitinsville Cotton Mills . .	Whitinsville, Mass.
Harry T. Whitin .	Rockdale Mill	Northbridge, Mass.
William H. Whitin .	Whitin Manuf. Co.	Whitinsville, Mass.
A. N. Whiting . .	Whiting Mills	Oakdale, Mass.
William S. Whitney,	Pocasset Manuf. Co. . . .	Fall River, Mass.
Eben Wilber . . .	Indiana Cotton Mills . . .	Cannelton, Ind.
Thomas Wilmarth .	33 Manton Avenue	Providence, R.I.
A. L. Williston . .	Greenville Manuf. Co. . . .	Northampton, Mass.
Hubbard Willson .	. . . . .	Cordaville, Mass.
George Wood . . .	Millville Manuf. Co. . . .	Philadelphia, Penn.
William B. Wood .	Continental Mills	Boston, Mass.
C. J. H. Woodbury .	. . . . .	Boston, Mass.
Daniel Wright . .	Appleton Co.	Lowell, Mass.

Total number of Honorary Members 2

Total number of Active Members 229

CALL FOR MEETING.

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION,
BOSTON, April 1, 1882.

DEAR SIR, — The stated annual meeting of the Association will be held at the Massachusetts Institute of Technology, Boylston Street, Boston, on Wednesday, April 26, 1882, at ten o'clock A.M. (with an afternoon session commencing at two o'clock), for the choice of officers for the ensuing year, and the transaction of such other business as may properly come before it.

Upon notice in writing given at the last meeting, an amendment to Art. 8 of the By-laws, proposed by Mr. EDWARD ATKINSON, will be in order for action thereon.

The amendment consists in adding the following to the present Art. 8: —

"Upon such report, new members may be admitted, if they obtain a majority of votes of the members present, upon signing the By-laws, and paying an admission-fee of ten dollars, and an annual assessment not exceeding ten dollars. Any member may withdraw from the Association at any regular meeting, upon payment of all arrearages, first giving notice of his intention so to do to the Secretary; and any member may be expelled *for cause* at any regular meeting, two-thirds of the members present voting therefor."

The entire Art. 8, if so amended, will read as follows: —

ART. 8. All nominations for membership shall be made in writing, at least one week before the date of any regular meeting, and shall be considered by the Board of Government, and reported to the meeting, favorably or adversely, for the action of the Association; provided, that in case the Board shall decide to report adversely upon any nomination, the member who shall have made it shall be informed of the intention so to report, in order that he may have an opportunity to withdraw the name. Upon such report, new members may be admitted, if they obtain a majority of votes of the members present, upon signing the By-laws, and paying an admission-fee of ten dollars and an annual assessment not exceeding ten dollars. Any member may withdraw from the Association at any regular meeting, upon payment of all arrearages, first giving notice of his intention so to do to the Secretary; and any member may be expelled *for cause* at any regular meeting, two-thirds of the members present voting therefor.

After the conclusion of the business of the meeting, by invitation of the Board of Government, W. E. WHITEHEAD, Esq., of Lowell, Mass , will present a paper upon the subject of Carding.

The Board have also the pleasure to announce that JOHN C. HOADLEY, Esq , of Lawrence, Mass , will address the Association upon the subject of Steam Boilers and the Consumption of Fuel.

Both the above subjects will be presented for full discussion, and, it is hoped, will be thoroughly developed by the members at large.

By order of the Board of Government.

AMBROSE EASTMAN,

Secretary.

PROCEEDINGS.

BOSTON, Wednesday, April 26, 1882.

THE annual meeting of the New England Cotton Manufacturers' Association was held at the Massachusetts Institute of Technology, April 26, 1882, at ten o'clock A.M. About one hundred and fifty members were present. The President, Mr. John Kilburn, occupied the Chair, and called the meeting to order, and requested the Secretary to read the call for the meeting. [The call was read.]

The PRESIDENT. The first business in order will be the reading of the records of the last meeting. The custom has been to omit the reading of the records; and, if no objection exists at this time, the reading of the records will be dispensed with. The next business will be the reading of the reports of the Secretary, Treasurer, and Auditor.

The Secretary read the reports, which were by vote accepted, and ordered to be placed on file.

The PRESIDENT. The next business in order is the election of officers. The custom has been heretofore to appoint a committee on nominations. The committee has usually been appointed by the Chair, consisting of three members. How shall we proceed at this time?

It was voted that the usual course be pursued; and the President appointed for the nominating committee Messrs. J. G. COBURN, R. B. BORDEN, and C. J. H. WOODBURY.

The PRESIDENT. While the committee are out, it will be in order for the Secretary to present the list of names that have been recommended for membership. The Secretary will please read the list.

The SECRETARY. The last meeting of the Board of Government was held on March 1, 1882, at which the following per-

sons were nominated, and were recommended for membership in the Association: —

Thomas C. Brayton	*Fall River, Mass.*
Crawford E. Lindsey	*Fall River, Mass.*
Alvan S. Lyons	*Fall River, Mass.*
Richard McCarthy	*Anniston, Ala.*
Robert Redford	*Lawrence, Mass.*
Charles E. Rogerson	*Newburyport, Mass.*
John C. Sharp, Jun.	*Boston, Mass.*
Joseph Shaw	*Fall River, Mass.*
Daniel Wright	*Lowell, Mass.*

On motion, it was then voted that the above-named gentlemen should be elected; and they were accordingly chosen.

The Secretary. The Secretary would state that several nominations came in too late to be acted on by the Board of Government, and therefore could not be presented to-day.

The President. The next business in order is action upon the amendment to Art. 8 of the By-Laws, proposed by Mr. Edward Atkinson. The amendment has been read by the Secretary; but there are several members who have come in since it was read, and perhaps it will be right to read it again.

The Secretary. The present Art. 8, as it stands upon our records, is as follows: —

"All nominations for membership shall be made in writing, at least one week before the date of any regular meeting, and shall be considered by the Board of Government, and reported to the meeting, favorably or adversely, for the action of the Association; *provided that*, in case the Board shall decide to report adversely upon any nomination, the member who shall have made it shall be informed of the intention so to report, in order that he may have an opportunity to withdraw the name."

The amendment offered for action to-day is to add the following: —

"Upon such report new members may be admitted, if they obtain a majority of the votes of the members present, by signing the By-Laws and paying an admission fee of ten dollars. Any member may withdraw from the Association at any regular meeting, upon payment of all arrearages, first giving notice of his intention so to do to the Secretary; and any member may be expelled *for cause* at any regular meeting, two-thirds of the members present voting therefor."

The amendment was adopted without discussion.

The President. The next business will be to hear the report of the committee on nominations.

Mr. COBURN. The committee respectfully submit the following report: —

For *President*, John Kilburn.

For *Vice-Presidents*, William F. Goulding, Richard Garsed.

For *Directors*, Charles L. Lovering, William H. Jennings, Charles D. McDuffie, Walter E. Parker, John W. Danielson, William E. Barrows.

It was then voted that the chairman of the committee on nominations be authorized to cast one ballot for the Association to elect the above-named gentlemen as the officers of the Association for the ensuing year.

Mr. Coburn then cast the vote for the Association, and the gentlemen named were declared elected.

The PRESIDENT. The next business before us will be the reading of a paper on the subject of Carding, by W. E. Whitehead, Esq., of Lowell, Mass. Mr. Whitehead is not able to be present. He has a representative here to perform the duty for him, — Col. Webber, of Manchester.

THE WHITEHEAD AND ATHERTON CARD.

BY W. E. WHITEHEAD, ESQ.

MR. PRESIDENT AND GENTLEMEN OF THE NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION, — At the request of the Board of Government, we beg leave to call your attention to our new cotton card, a drawing of which we show you as follows: viz., —

A, feed rolls; B, first licker-in; C, second licker-in; D, main cylinder; E, edge of extractor; F, slide for placing and holding leaf-extractor; G, knives of leaf-extractor; H, doffer; I, Condenser rolls; K, railway trough.

We claim for this card various advantages over the cards in ordinary use, and especially the one of disposing of the greater part of the heavy dirt before the cotton reaches the top-flats.

The licker-in, B, first takes the cotton from the feed-rolls by a downward blow, which throws out some of the heaviest dirt; and the blow of the main cylinder on the cotton, as it takes it from the second licker-in, C, tends to throw a large portion more directly against the sharp edge of the casing, at E; while the remainder of the leaf and sand is almost entirely caught by the sharp edges of the knives, G, G, which, while cutting off and holding the bits of leaf and seed, also help to straighten the fibres of the cotton and lay them into the clothing of the main cylinder.

By getting rid of the sand, mote, and leaf in this manner before reaching the top-flats, we claim to produce cleaner carding than it would be possible to do if the leaf and seed were permitted to be chopped up and mixed with the fibre, as is the usual case with any other card using flats or rollers; and also to preserve the card clothing in much better condition, and more free from wear and tear.

This leaf-extractor can be easily drawn out and emptied without loss of time; and will be found, when doing so, to have collected the heaviest dirt at its front edge, the weight and quantity gradually diminishing until it reaches the top-flats, where very little leaf will be found to remain.

This extractor is also adjustable, and can be set so as to bring the edges of the knives at any desired distance from the

card teeth on the cylinder, from one-eighth of an inch to the thickness of a sheet of paper.

We also claim another advantage for this card, in the flatter surfaces due to its increased diameter, thereby enabling both the flats and the doffer to card the cotton more thoroughly than would be possible if the cylinder were of the ordinary diameter of thirty-six inches, or smaller; and we also claim that, by means of this larger diameter, we get a larger carding surface, with a less number of revolutions per minute, and consequently less centrifugal force tending to throw the cotton out of the cylinder; and we wish to lay particular stress on the carding action of the doffer itself, due to the large diameters of both the doffer and main cylinder.

Another point to which we wish to call your attention is the action of our self-stripper, which has two speeds, — one, that of its regular motion around the cylinder when it is driven from the doffer, and stops when the feed is stopped; and the other and quicker speed, at which it strips the flat, when, by shifting the belt, it is driven from the main cylinder.

When the stripper is passing from one flat to another, the motion is slow; but, when the cam is seated to pick up the flat, its action also operates a shipper, which shifts the belt from the slow to the fast pulley, so that the flat is picked up, stripped, and put back in place, in four seconds, at the usual speed of the card.

When the flat is seated again, the same cam ships the belt back to the slow pulley; and six or seven seconds, or such time as the carder may prefer, are occupied in carrying the stripper over to the next flat.

The advantages of this arrangement are, that the flat is kept away from the face of the cylinder for the shortest time consistent with safe and careful handling; the cotton which usually accumulates, to a greater or less degree, on the edge of the flat next to the one which is being stripped, does not have the same chance to collect by this arrangement that it has with the ordinary stripping motion, where from twelve to fifteen seconds are occupied in the process of stripping the flat, and putting it back in place: consequently the work will have less "*goups*," or bunches, less clouded places, and must be evener and clearer.

A sliver delivered by this card is evener than one from a card with the ordinary stripper, doing only seventy per cent of the same quantity of work from the same laps.

A number of these cards now working have worked seventy pounds of cotton per day, which has been put into No. 30 warp, in a very satisfactory manner.

The waste made is practically worthless, as only the broken, short, and useless cotton is thrown down with the heavier dirt, while the waste from the top-flats is reduced both in quantity and quality, as has been shown by several months' experience.

We claim, by the application of the top-flats to a larger cylinder, to reduce the bevel which is necessary to adapt them to a small one, and to get a larger effective carding surface, as well as to get rid of a large quantity of flying waste, which is thrown off from any card with a small cylinder, when at a high speed, by their centrifugal action, owing to the increased amount of dead space left in fitting the flats to the arc of a smaller circle.

We claim that, in this mode of handling the cotton, we are working in accordance with natural laws, as we are aided by the force of gravity in removing the dirt, both in the first action of the licker-in, when it takes the cotton from the feed-rolls, and at the contact of the main cylinder with the second licker-in, where the heavy dirt has a clear space to fall away from the card before reaching the knives; and the action of the latter in actual use shows that there is very little dirt left to fall in between the last ones: so that the cotton reaches the flats in a very clean condition, and, from their large surface and number, receives as much carding as on any *flat* card.

And it will be seen by the construction of this leaf-extractor under the card that it is a permanent thing, and not liable to get out of order, and it is so arranged that any boy can take it out and put it back with safety, without the least liability of hurting the clothing on the cylinder.

There is another point in regard to the stripper-motion, which is that, it being driven from the feed-shaft while travelling from one flat to the other, it reduces the liability of the sliver to be broken down at the doffer to a minimum, when the railway head is stopped and started, which is the cause of broken

slivers with other cards, when the stripper-motion is driven from the main cylinder, as the stripper is continually emptying the flats while the main cylinder is running and railway-head stopped, which is not the case with ours.

It will be seen, by examining the card, that we have kept a strict adherence to simplicity, on purpose to avoid having to employ any skilled help, further than is necessary to run the common top-flat card.

What we claim for our card is this: *First*, Taking the dirt and foreign matter from the cotton before it enters the flats, in such a manner as to be aided by natural laws. *Second*, Increased effective top-flat carding surface, by the use of a cylinder of large diameter, but occupying very little more floor space than the common top-flat card. *Third*, Carding the cotton without losing any good fibre, the waste being worthless.

The PRESIDENT stated that Mr Atherton had presented samples of cotton-carding on the Whitehead and Atherton card, and dirt extracted, which were placed upon the President's desk, and were open to inspection of the members of the Association.

Mr. ATKINSON. Mr. President, it is usually my function to throw out audacious theories, and stir up a discussion. Having no responsibility, I can do it much better than the practical agents, and run my own risk of showing what I don't know. There, no doubt, will continue to be a necessity to use the card for its unsuitable purpose of cleaning cotton for many years to come, — the work which we all know ought to be done before the cotton gets there. It is very obvious that the carding-engine, unsuitable as it is for this purpose, will be used for many years to come, — until the combing-machine, or its equivalent, is rendered capable of doing as much work as the card. Now, from the theoretic standpoint (or I may go back to the old, practical standpoint of David Whitman), there seem to be some great merits and some grave defects about this card. Theoretically speaking, there can be no question, I think, that the larger cylinder is better than the smaller one. That appears to have been the conclusion reached by our English friends; and there is generally a reason for the conclusion that the Englishmen reach, — a good one, although they may be in some respects a little slower than we are. But there is also a great merit in this card in adopting substantially the principle of sifting the dirt at the right place, which formed a part of what we call the mote-catcher of Mr. C. J. Goodwin and myself, which we introduced some years ago, and dropped for the reason that we found that "patentee" and "pickpocket" begin with the same letter: it was not a pleasant business to pursue. This card takes the dirt practically at the same point, to wit, at the point where the fibre is delivered to the main cylinder. Our mote-catcher, as we called it, you may remember, left a space over the first feed-roll of the common card and the first top-flat. We took advantage of the centrifugal motion imparted to the motes and dirt to throw them away from the cylinder, and we caught them in a trough. It served a most excellent purpose, and is still serving an excellent purpose in a good many mills. I observe that our friend Webber criticised that device lately in "The Industrial Record," but it would seem he had never looked at the work. He alleged that the same could be done at the other

end. But he was quite mistaken; and, if he will examine the matter himself, he will find it so when he sees my answer.

Now, the fault in this machine, from the theoretic standpoint, consists in the old objection urged by David Whitman to the licker-in, — the overworking of the cotton. Every time you strike a fibre of cotton, whether with the blade of a picker or an opener, or the tooth of a saw, or the wire of a card, you are doing some mischief; and, the more frequent and the more severe the blows with which you strike the fibre, the more injury will be done. It therefore seems to me that the fault in this card is in interposing two lickers-in, each of them working at a high speed, and impairing every fibre of cotton which they touch. It is perfectly clear that, where the fibres are delivered to the card-cylinder by the ordinary feed-rolls, each particular fibre of cotton is more completely separated from the next fibre, and treated more individually, so to speak, than it ever is at any other point in the whole process. Motes and leaf are therefore more perfectly detached at that point, and a method of getting that mote and leaf out at that point is right. I think, however, that the presentation of the edge of the lap by the ordinary fluted feed-rolls to the card-cylinder offers a better opportunity for the motes and leaf to leave the fibre than where the fibres are taken off from the licker-in by the card-cylinder, and that the nearer the mote or leaf-catcher can be placed to that exact point of delivery where the main cylinder teeth take the fibre of the cotton the more perfectly will that part of the work be done. I should, therefore, give theoretically the preference to the ordinary delivery by feed-rolls over the lickers-in, both for the reason that they will impair the cotton less, and that they will give a better opportunity for the leaf and dirt to leave the strand. But whether the ordinary feed-rolls can be applied to this particular kind of card is not stated. I assume that they can be.

Now, then, in connection with the general question: since our last discussion, in which exception was taken, and rightly taken, to the function of the card as a straightener of the fibre, or a machine by which the fibres were in some measure laid parallel to each other, I have tried to give a little theoretic attention to the point. It is clear that the fibres are laid parallel upon the main cylinder — substantially parallel. If they could be taken off by the doffer and the doffer-comb in the same align-

ment in which they are placed upon the main cylinder, a great deal of the work of evening them afterwards on the drawing-frames and roving-frames would be avoided. It is curious, however, to observe that, by the action of the doffer and doffer-comb, the strand, when it leaves the doffer-comb, is more tangled than it ever is afterwards or ever has been before. I observe that the straightening of the fibre is compassed more by the abrasion of one fibre against another in the strands than it is by the application of any particular mechanism to the cotton; therefore the process of evening is worked by the cotton itself in its passage from machine to machine; while the machinery merely puts the cotton in the way of evening itself. Now, this may be very elementary, and it may be very foolish; but, if you will observe closely that process, you will reach the conclusion that the carding-engine is, to a certain extent, a machine unsuitable to be used as compared to a true combing machine.

On the other hand, in the combing-machine, a grave fault occurs for the reason that the fibres are taken in detail, or nipped, you may say, section by section of the strand, so that there is no miscellaneous overlapping of fibre against fibre; there is a succession of fibres laid even to each other, and then a break, and then another succession. I understand that a sliver from a comber will hardly hold itself. It has to be lifted up from below in order to be drawn. My attention was very closely called to these branches of the subject by observing the operation of the Clement attachment, which we spoke of at our last meeting, in which cotton, slowly and carefully ginned and cleaned in the cotton-seed cleaner before it came to the card, was worked successfully — probably not economically, but worked successfully — into an even and true strand, on a common thirty-six inch card, at the rate of one hundred pounds to a card per day; and if the product were put alongside of this it would be easy to see which has the best appearance. In this apparatus one could observe very closely the tangling of the fibres as they left the doffer, and the straightening of the fibres as they passed through the rolls by their own action each upon the other. It therefore seems to me that this is another case where, in consequence of the bad and unfit condition of the cotton as we now receive it, we are obliged to use the card for a purpose for which it ought not to be depended upon. And

I think that this card is in some measure like unto many of the complex improvements in spinning, — a step in the wrong direction; a step towards complexity rather than simplicity in action.

Col. WEBBER. Mr. President, if I may be permitted a word of personal explanation, my friend has rather pitched into me for criticising something I had not seen. If the editor of "The Record" had not taken out a part of my article, because he thought I stated the facts too strongly in favor of a particular card, Mr. Atkinson would have found my argument to be in favor of striking cotton down to get rid of dirt instead of tossing it upwards.

Mr. ATKINSON. The colonel is right there. I would also call attention to another little point, to which my attention was called by Dr. Osgood, the inventor of the Osgood gin, whom I carried to a mill to study the subject of carding, as he seems to know a great deal about the nature of cotton fibre. We took some of what you may call the first quality of card-waste, or first and second quality of card-waste. When you first examine, it appears to be very short fibre. And yet, if you will take that same waste, and draw it carefully between your thumb and finger, condensing it and warming it for two or three minutes, you will find that, instead of being short flyings, it is to a very large extent the finest and longest fibre that there is in the cotton; which, if it could be kept in, would fill up the interstices in the coarser fibres of the yarn itself, and would therefore serve a most useful purpose. I think it is the most mature cotton because it is shortened, as the microscope shows, by the exceedingly numerous convolutions retracting it and making it appear short. If any of you will test this, you will find that what appears to be waste is the finest cotton.

The PRESIDENT. Gentlemen, I would like to say one word on this point under discussion at this time, because it seems to me there has been one vital point left out of Col. Webber's description, one of the strong points. I understand the licker-in to be a matter of taste; that it can be used in this card, or the common roll can be used. But what I discovered in the action of this card was this: that, while the leaf was deposited below, no cotton was left, and the fibre went through, leaving a quantity of dirt in that receptacle at the bottom. After it had been running two days and a half I could have held it in my two hands this way [illustrating], but all the fibre I could

have held in my one hand closed. It struck me that it had many advantages over any sort of screen that had ever been put under a card, and that the waste was very little.

Mr. ATHERTON. In regard to Mr. Atkinson's objection to lickers-in, that is a mere matter of taste. We have a card running at the Merrick Thread Company to be used on Sea Island cotton; and it is so successful, as against the other card, that we have an order for their new mill for twenty-four cards, to work exclusively on Sea Island cotton, without lickers-in.

Mr. DRONSFIELD. Mr. President, I would like to ask the gentleman the number of top-flats in this card, and also the speed of the doffer in putting through the sixty pounds of cotton a sample of which he has got there.

Mr. ATHERTON. Mr. President, in answer to the gentleman I will say that the speed of our doffer is eight revolutions per minute, that is, the regular speed when it is doing sixty pounds. The diameter of the doffer is sixteen inches on the face. I have a record of a test that was given me by Mr. Bean, the superintendent of Merchants' Mill, Fall River. This test was made Jan. 22, 1882. There were three laps put on to the Whitehead and Atherton card, weighing eighty-seven and three-fourths pounds: the weight of the strip was sixty ounces; of the fly, twelve ounces; cylinder strips was twelve ounces. This was doing at the rate of sixty pounds per day. The common Wellman top-flat card used three laps, weighing ninety pounds: weight of strippings fifty-four ounces; fly, fifty-one, as against twelve ounces on the Whitehead and Atherton card; cylinder strippings was six ounces, as against twelve ounces on the Whitehead and Atherton card, — making one hundred and eleven ounces waste altogether. This card was doing thirty-six pounds a day at that time, against sixty on the Whitehead and Atherton card.

Mr. DRONSFIELD. I did not understand the gentleman to say how many flats there were on the card.

Mr. ATHERTON. Twenty-seven.

Mr. O. S. BROWN. I noticed that on the Foss and Pevey card, and also on the Whitin card, they have a licker-in. Now, my experience with lickers-in has not been very pleasant. I have been told they are put on for the protection of the cylinder. If there is any gentleman here who has used lickers-in, and taken them out, I would like to know whether he has found

them any protection to the cylinder or not. I have not found them so, but found them a damage.

Mr. President, as that does not seem to meet with any response, I will ask another question. I would like to know if there is any gentleman here manufacturing yarn from 60's to 80's who would dare use the card with the licker-in in.

Mr. ATHERTON. In answer to that, I will say that the parties who make fine threads do not use lickers-in in working Sea Island cotton. They work it right from the feed-roll. They must consider that as an advantage, or they would not do it, and they all do that.

Mr. PRAY. I would like to ask if our spinners of medium numbers were satisfied with the same production per card that the finer spinners, like the Willimantic Linen Company and others who are running from sixty to one hundred and twenty are satisfied with, and instead of asking for eighty or ninety pounds on a card were contented with fifteen to twenty-one pounds per card, as in the case of Sea Island cotton, whether lickers-in would be either desirable or advisable in any case, and if this has not something to do with the question.

Mr. BROWN. I think that has not any thing to do with it. I have had some experience with cards both with and without lickers-in. I had some cards that were built with four rolls to prepare the cotton before going on to the cylinder, or I might say to protect the cylinder. We first took only two, then another, and finally, to try the experiment on a few cards, I took them all out. We watched the result carefully, and found not only that the lickers-in were no protection to the cylinder, but that our carding was much better, as with the lickers-in the carding was flaky, but without them we made smooth and much cleaner carding. Aside from that I don't think that I saw any difference in the cylinder at all, but in the working of the card I did see a great difference. I was not able to make any carding except what was clouded, and I do not think anybody else ever did; but without the licker-in I can make straight carding.

The PRESIDENT. Gentlemen, have you any thing further to offer on the subject of carding? If not, I would like to say a word or two on the subject of lickers-in. I have had only a limited experience with them personally; but since I went to Lowell, four years ago, I have made a great many inquiries in

relation to the use of the licker-in, which, in addition to the limited experience I have had, has led me to some conclusions in relation to it. In Lowell, the licker-in has been used, in years gone by, more extensively than elsewhere, I believe. I find very few people there to-day who advocate the licker-in for any sort of a purpose; that is to say, for the purpose of making cotton yarn for weaving into cloth. And in many cases where they card, the lickers-in have been removed from the card. I found the testimony was a very decided improvement in the work done. In my own experience, I once applied lickers-in to cards for the purpose of making bats, and felt they were just the thing for a battened card. I afterwards was led to try to do the same work on an ordinary card; and I found that I could make bats worth nearly a cent a pound more upon the common card than I could with the licker-in upon the cards which I tried to do it with.

That experience, and the testimony that I have gathered in Lowell, led me to the conclusion that it was one of the things that I should only use for some special purpose, which I should not now be able to name, but would take the ordinary card in preference.

Mr. Hoadley, who was to have addresed the Association to-day, has not yet arrived. He has been detained for some reason, I do not know what. We hope to hear from him soon. It might be well to occupy the intervening time with the presentation of this set of models which have been prepared by invitation of the Board of Government for exhibition to the members of the Association, showing different systems of belting. These were previously exhibited to the Association, and some others have been added since. If Mr. Hill is present, we should be glad to hear from him, if the Association so elect.

A MEMBER. Mr. Hill has stepped out for a few moments.

The PRESIDENT. Mr. Green presents me with a vote on the subject of Assessment, which reads as follows: —

Voted, That the Board of Government be authorized to lay an assessment upon the members of the Association for the year 1881, to meet the expenses of the current year, not exceeding ten dollars, as limited by the By-Laws.

According to the practice of the Association, only those

members will be assessed who were members in 1881. Those who were admitted during 1882 will not be assessed.

The motion was carried.

The PRESIDENT. I see that Mr. Hill has now returned. The question for the Association to decide is whether this matter shall be taken up at this point or not. The models have been presented here by the request of the Board of Government through its secretary, and Mr. Hill has some points which he wishes to explain to the Association which he failed to explain to them at the last meeting. If it be your minds that you take up the subject now, I would be glad to hear a motion to that effect.

It was then voted that Mr. Hill be invited to explain the models. Mr. Hill then proceeded to explain in a very interesting manner the workings of the various models on exhibition; but his explanation and illustration of their operation was of such a nature that it could not be reported.

Mr. ATKINSON. I want to give notice of a proposition which I wish submitted concerning an exhibition of cotton machinery, and, as it might possibly not come before the meeting till after lunch, I would like to have all the members understand it. At a later time I will submit this, and give the reason for its submission.

JOHN C. HOADLEY, Esq., of Lawrence, Mass., then addressed the Association upon the subject assigned him, as follows: —

STEAM BOILERS, AND THE CONSUMPTION OF FUEL.

BY JOHN C. HOADLEY, ESQ., OF LAWRENCE, MASS.

GENTLEMEN, — It will doubtless be plain enough in the end that I ought to begin by apologizing for appearing before you without a matured and written communication. Among the eight or ten pages of notes which I have before me there is probably not a single complete sentence. Not a word of it was written before eight o'clock last evening; but the subject was tolerably familiar to me, and, as I have been engaged recently in labors which have refreshed and increased my knowledge of the subject, I hope I may be able to say something worthy of your attention.

Elaborate experiments have been going on for some time at Lawrence, at the expense and for the benefit of a number of subscribers, comprising some of the largest manufacturing companies in the State and in New England. They are not quite complete. The experiments are completed, and the notes are completed; but the revision of the work, which will finally result in giving us a few figures as the net result, is not complete. There will be probably no great change from the figures as they now stand, but there may be a small variation. It is proper to state that the results of these experiments are at present the private property of those who caused them to be made, and without their permission I should not presume to make them public. So far as the specific results of these experiments are concerned, such permission I have neither obtained nor sought. I have spoken about this address to some of the gentlemen interested, who had no objection; but they could not speak for their associates. The results will undoubtedly be made public; and I presume, judging from the inquiries which are made for them, they may have an extensive circulation, and be accessible to all before a very great while.

One of the most important results, in my opinion, of our course of experiments, was to ascertain that, under ordinarily careful conditions, there is no very great loss resulting from incomplete combustion. Unless extreme carelessness is introduced; unless, indeed, there is a set purpose and determination to cause incomplete combustion, and persistent means are ap-

plied to that end, there will be substantially complete combustion. The process of analyzing gases, which was continued during many weeks at Lawrence, consisted, in the first place, of taking complete samples of chimney gas; and, for my part, I could hardly credit the fact, when I found that in two parts of the same flue, hardly more than two feet apart, the flue-gases might differ very widely. To each tube two sets of analyzing bulbs were connected, so that they gave a double analysis for mutual verification, and the duplicate analysis was substantially the same, each set of analyzing bulbs showing the same composition of gas; yet the gases in the two tubes would differ very widely, so widely it could hardly be supposed they were taken from the same chimney, even at different times of the day or different seasons of the year. So it became necessary to introduce twenty-five tubes, extending to different parts of the flue, and to obtain mixed gases, drawn from different parts of the flue, before we could be sure or have any kind of confidence that we had obtained a sample of the gas in the flue. The mixture produced in this way, from two separate mixing boxes, gave us samples which, drawn off and analyzed separately, produced uniform results, obtained again and again many times, so that we feel very confident of having obtained a correct sampling and analysis of the chimney gas.

This system of drawing samples of gas and the analysis of it was usually continued through an entire forenoon, an entire afternoon, and an entire night; the work of twenty-four hours consisting of a series of three analyses each day of the whole week. Occasionally, when some special mode of firing was going forward, as when there was a fresh fire, or when fresh coal was thrown on before the last previously fired coal had been fully ignited, it was thought desirable to take samples every half-hour, or oftener, in order to ascertain the qualities of gas during the continuance of this special mode of firing, or particular condition of the fire. In that way, extreme efforts were occasionally made to obtain carbonic oxide, that is, C O. The quantity of that gas in the gases of a chimney is usually very small. We only got a fraction of one per cent, running as low as .08 of one per cent, and rarely up to .30 of one per cent, without persistent bad firing. Now, this seems a small amount, but it is by no means despicable; for the *loss* resulting from a certain proportion of carbonic oxide in the smoke is

from seven to eight times as great as the percentage of carbonic oxide itself in the smoke. The quantity of carbon in a given quantity of carbonic oxide is $\frac{3}{7}$ of the whole quantity. In carbonic acid it is only $\frac{3}{11}$; so that in 100 lbs. of flue gases a given number of pounds of carbonic oxide (C O) contain a much larger quantity of carbon than would be contained in the same number of pounds of carbonic dioxide ($C O_2$). Besides this, of the total quantity of heat which carbon is capable of producing by complete combustion to $C O_2$, only .3 is produced by its distillation as C O, .7 being lost; and the reduced quantity, .3 of the whole, is of course subjected to losses of various kinds, as by radiation, by the escape of hot gases to the chimney, etc., as great in actual amount as if the full heat of complete combustion were obtained,—obviously a much larger proportionate loss. It must also be borne in mind that for every pound of coal there are twenty to twenty-five pounds of flue gases produced; so that the one pound of coal is only four or five per cent of the gases; and, since only say 80 to 85 per cent of the coal is carbon, this carbon will constitute no more than $3\frac{1}{2}$ to $4\frac{1}{4}$ per cent of the gases. Further, since the carbon is $\frac{3}{7}$ of carbonic oxide, the quantity of this gas will be $\frac{7}{3}$ of the carbon contained in it. Now, $3\frac{1}{2} \times \frac{7}{3} = 8.2$, and $4\frac{1}{4} \times \frac{7}{3} = 9.9$; and we find that eight to ten per cent of C O in flue gas would indicate the entire conversion of all the carbon consumed into this gas, and the production of only .3 of its full heating power. The loss entailed, therefore, by the production of small and apparently insignificant quantities of C O, is by no means inconsiderable. But it never need, and rarely does, exceed one-fourth of one per cent, causing a loss of rather less than two per cent. This small quantity of carbonic oxide is absolutely the only combustible substance which, in the combustion of anthracite coal, can ever be found in the flue gases. To burn this is all that can be sought or hoped for by the adoption of any process, patented or otherwise, for admitting air above the grates, whether through the fire-doors, through flues in the brickwork, through a split-bridge, or in any other manner.

Now, this quantity of C O, small as it is, is mostly made, in my opinion, at the time of firing and clearing the fire. It is necessary to open the fire-doors for the sake of cleaning the grates, and, when the doors are opened, the draught is more easily supplied through them than through the grates and

coal; and the consequence is, the passage of air through the coal is more sluggish, the supply of oxygen is somewhat inadequate, and carbonic oxide begins to appear. In all the ordinary modes of firing it is necessary to have the door open more or less, and frequently as much as one hour out of ten, and there will always be some carbonic oxide in the smoke at such times; but the quantity will always be increased by admitting air above the fire, whether through the door, through the thick walls, or in any way above the fire, simply by diminishing the flow of air through the coal. Now, if some mechanical method of stoking could be found, free from the objections which have always appeared in that mode of firing, it would be extremely desirable, so as to avoid opening the door. Of course there are often difficulties arising from the fire being too thick in one place and too thin in another, which very much diminish, if they do not quite neutralize, all the benefits to be obtained from mechanical stoking. As for the admission of air above the fire, it has been thought that very great advantage would be obtained from admitting *hot* air above the fire in fine jets. Many attempts have been made in that direction. But hot air, so called, is far from being so hot as the air which has just come through the fire, and which has oxygen in a perfect state for combination with carbon. There must always be a large excess of oxygen: not all, by any means, that enters the fire can be combined, and leave the fire in combination as carbonic acid. To illustrate this point: Suppose you have a quantity of mustard-seed to represent nitrogen, and mix with it a quantity of hay-seed to represent oxygen. You have about three and a half or four times as much mustard-seed as hay-seed, and they are uniformly mixed, so that there is a slight sprinkling of white throughout the whole mass; and we will suppose that they preserve a uniform relative combination under all circumstances. Such is the condition of oxygen and nitrogen in the air. There is no chemical compound, but a mixture; and they jointly occupy the space, doubtless in rapid vibration, but they occupy it, each as a vacuum to the other and to other gases. If you undertake to pick out the white seed, when you get half of them picked out you will find those remaining a great deal more difficult to get at: you cannot see them so plainly, and there are more black seeds in the way. Now, the oxygen and

carbon do not unite so readily when you have absorbed a large part of the oxygen from the air. Each molecule of oxygen is surrounded by a mob of molecules of nitrogen, which screen it in some degree from the contact of the molecules of carbon. Nor can any possible subdivision of air by mechanical means, such as perforated places or tile, give even an approximation to such an intimate mixture as of necessity exists between the combined and uncombined molecules of oxygen in air admitted through the coal. Two molecules of oxygen unite with one molecule of carbon, the three molecules are condensed to the original volume of the two molecules of oxygen; and the work of condensation done on the air by chemical affinity shows itself as *heat*. But two neighboring molecules of oxygen, separated from the first by a minute space which may be immensely exaggerated by calling it one millionth of an inch, pass on uncombined, and escape with the smoke, to mingle with the kindred molecules of oxygen in the outside air, unchanged. No mechanical mixture can rival this in thoroughness and intimacy.

Oxygen, in uniting with carbon, produces a very great amount of heat. Every pound of carbon, united with 2⅔ pounds of oxygen, produces 14,500 thermal units.

The temperature that results from the production of this quantity of heat depends upon the kind and quantity of matter it is diffused through. Water is the standard. The quantity of heat which just suffices to change the temperature of freezing-cold water one degree is called a unit of heat. The ratio which the quantity of heat required to change the temperature of any substance (or any particular form or state of any substance, as solid, liquid, or gaseous) one degree bears to the heat unit is the specific heat of that substance and state.

Thus the specific heat of air at constant pressure is 0.2377, commonly taken as 0.238; so that the same quantity of heat that will raise one pound of cold water one degree of temperature will raise 4.2 pounds of air one degree. Mixed as are the flue gases, each gas having its own proper specific heat, they yet differ so little in that respect, and the quantity of atmospheric air so greatly preponderates, that the specific heat of "smoke," i.e., flue gas, may be called 0.238. The specific heat of anthracite coal is about 0.2, or one-fifth that of water.

Now, since one pound of carbon, on combining with 2⅔ pounds of oxygen, to produce 14,500 units of heat, must heat not only these combined elements and all associated elements as well, the temperature will be greatly reduced. The complete combustion of carbon may be represented in the following diagram: —

ELEMENTS.

1	pound of carbon,
11.6	pounds of atmospheric air,
12.6	total.

PROCESS.

Carbon	1	pound,
Oxygen	2.66	pounds,
Nitrogen	8.94	pounds,
	12.60	total, as before.

PRODUCTS.

Carbon dioxide		3.66
Nitrogen		8.94
	lbs.	12.60
Add 100 per cent surplus air	lbs.	11.60
Total weight of flue gases per pound of carbon		24.20

If the coal contains eighty-two per cent of carbon, all the preceding numbers must be multiplied by 0.82; and, for one pound of such coal, our diagram becomes,—

ELEMENTS.		PROCESS.	PRODUCT.
C	0.82	C, 0.82	
		O, 2.18	CO_2, 3.00
Air	9.51	N, 7.33	N, 7.33
	10.33	10.33	10.33
Add 100 per cent surplus air			9.51
Total weight of flue gases per pound of coal			19.84

When the flue gases exceed twenty pounds per pound of coal, as they often do, of course the excess is atmospheric air.

But it must be remembered that we shall not have a certain quantity of free nitrogen, from which all the associated oxygen has been withdrawn, and along with it another quantity of atmospheric air, with due proportion of oxygen and nitrogen; but a mixture, more or less complete, of oxygen and nitrogen, in which the former is greatly less, — one-half less, — and the latter undiminished; with the carbon-dioxide.

The resulting temperature will therefore be from 2,500 to 3,000 degrees F. in the heart of the fire. It can never be so high at the top of the fire, — never nearly so high at the bridge wall, because heat is radiated directly from the fire to the boiler, and almost completely absorbed by the sooty surface of the iron, and transmitted to the water, leaving the gases cooler by 800°, 1,000°, or more, at the bridge wall. Indeed, 1,500° F. at the bridge wall is a high temperature.

The anthracite coal used at Lawrence gave, on analysis of samples obtained from every firing, 82.43 per cent of carbon, and a little hydrogen (1.86 per cent), and had a heat-producing power of 13,097 heat units, and an evaporative power of 13.56 pounds of water, from and at 212°. This is, of course, subject to certain inevitable losses, some of which can, however, be considerably reduced by care and suitable arrangements. A good deal of loss occurs at night by incomplete combustion of banked fires, with imperfect dampers. Perfectly tight dampers are the only remedy for this. Excess of air supply would cause but little loss if the gases could be cooled down quite to the temperature of the external air. This condition cannot be realized, but, by suitable arrangements, can be approximately reached, — and the closer the better.

With natural draught, and rather slow combustion, we succeeded, in the Pacific boiler, in bringing down the temperature in the smoke-box, during six weeks, to 385°, 373°, 371°, 365°, 348°, and 377°, — a mean of 369.8°, say 370°. This is very low, much lower than usual, and about as low as possible with natural chimney draught. With the Marland apparatus we had, for two weeks, 196° and 189, — a mean of 192.5°. The difference, therefore, was 177.3°; and as the gases, per pound of coal, were 25.93 pounds, equivalent, in capacity for heat, to (25.93 × 0.238) 6.17 pounds of water, we have 6.17 times 177.3, equal to 1,094 heat units, saved and returned to the fire for each pound of coal burned.

The heat of vaporization of one pound of water, from and at 212°, is 965.7 heat units; so that, dividing 1,094 by 965.7, we have the evaporation of 1.13 pounds of water added to the actual efficiency of each pound of coal.

If we take the quantity of water evaporated during the day, while steam is wanted for use, and divide the number of pounds of water by the number of pounds of coal consumed day and night, throwing out the evaporation at night as of no value, the water evaporated from and at 212° per pound of coal, during six weeks, with natural draught, was 9.32 pounds; and for five weeks, with anthracite coal, 9.34 pounds. The addition of 1.13 pounds to this, making 10.47 pounds, shows a gain of 1.13 divided by 9.34, equal to 12.1 per cent, or more than 11 per cent above the cost of running the blower.

Other methods of comparison show a similar result. It will be seen that here is no mysterious process of augmenting the quantity of heat by any hocus-pocus of pretended smoke-consumption, or what not, but simply the good, old-fashioned method of economy.

Having burned the fuel as perfectly as possible, and obtained from the gases of combustion all the heat possible to obtain in the flues of a boiler, with natural chimney draught, we simply extract nearly one-half of the remaining heat, and return it to the furnace in the air which fans the fire. I had visions of reducing the flue-gases to 134°, and got down only to 192°; but there is room for improvement in the apparatus. And it must be remembered that this comparison is not with ordinary practice, — even good ordinary practice, — but with almost theoretical conditions. The main chimneys of some of the largest mills in the State show from 400° to 530° as mean temperatures of the escaping gases. These, cooled even down to 192°, would show a return to the furnace of from one-half to two-thirds of the heat now lost, and a saving of more than fifteen per cent.

The efficiency of the boiler is greatly increased by the command of the draught given by the blower, so that, whenever required during the busy hours of the day, two or three times as much steam can be produced per hour as by natural chimney draught, — an advantage which goes to reduce, if it does not overcome, the augmented first cost of the plant with abstractor and blower. Indeed, it seems probable that, for a given steam-

supply, the cost of boilers, abstractors, blowers, and chimney will be little, if any, more than that of boilers and chimney alone, for natural chimney draught. It was thought that water-grates would be necessary, and a costly water-grate was put in; but it leaked, and I replaced it by a cast-iron rocking-grate, which seems to stand the heat very well.

I think the grates will require renewal oftener; but how much extra expense this will entail can only be ascertained by experience. A mode of construction for the Marland abstractor, materially cheaper than that first built, has just been started, and seems, so far, to answer. The whole apparatus is now in practical working, under the sole management of the men in charge before the experiments began; and any defects, inconveniences, and drawbacks will be likely to reveal themselves.

The steam superheating arrangement, designed to prevent the presence of entrained water in the steam, with rapid evaporation in the Marland boiler, which might have given a fallacious appearance of gain to the new process, has been changed to the ordinary form of setting, to insure greater safety and durability to the boiler in case water is carried too low. The arrangement, while in use, answered its purpose perfectly, and was essential to the experiment, as calorimetric experiments to determine the quality of the steam are extremely laborious and delicate, and give results, after all, rarely quite satisfactory. I have now covered the topics which I had laid out, and shall be happy to answer any questions.

It was then voted that the thanks of the Association be tendered to Mr. Hoadley for his interesting address.

A MEMBER. As it is not quite time to adjourn from this morning's meeting, I suggest that Mr. Atkinson speak to us in relation to the exhibition this fall.

Mr. ATKINSON. Mr. President, I beg to present, by title, an article upon "Cotton Improvement," which is printed in the supplement of this morning's "Journal." The Board of Government will take such action about printing it in the report as they may see fit. In connection with that subject I offer the vote which I have already referred to, which is as follows: —

Voted, That the Board of Government be requested to see what action may be taken by the Association to secure an exhibition of seed-cotton

cleaners, gins, presses, and other apparatus connected with cotton, at the fair of the New-England Manufacturers' and Mechanics' Institute, beginning on the first Wednesday in September, and to call a special meeting to act upon their report, if deemed by them expedient.

I have treated this subject so fully in "The Journal," this morning, that it would be superfluous to add much to it; and I merely call your attention to the great fact which had escaped myself, and, I think, had escaped many others before, — that during the transition state from the old-fashioned farm-gin and farm-press, operated irregularly and slowly, without much need of pushing the work, to the steam-ginning, doing the work of a neighborhood, I say that in that transition state, and until the steam-ginning process is thoroughly reformed, there is a constant, steady, and increasing depreciation of the quality of the cotton crop. That change from farm-ginning to steam-ginning is going on with considerable rapidity; and as I am now informed there is more difficulty, even in this dry season, with a cotton crop that ought to have been of the best quality than there has usually been. I think it may be fairly attributed to this change in the method of preparing and operating upon the cotton at the South. The steam-ginnery is worked for toll, or for money. The object of the owner is to rush through every bale of cotton that he can possibly treat. The object of the farmer is to get his cotton ginned quickly, and to get away as soon as he can. The result of that is, that the makers of the cotton-gin are now recommending them almost exclusively on their alleged capacity to turn out large quantities of cotton; and they are offered as being capable of doing from sixteen to twenty bales of cotton in a day, and of stripping the seed clean, when, in fact, the utmost that an eighty-saw gin ought to be called upon to do in a day is ten bales; and stripping the seed clean is the worst possible method that can be applied. Therefore there is an increasing quantity of gin-cut, badly-treated cotton. What is to be the remedy is not so apparent. I have treated the subject fully in the paper, and I will refer you to that.

I will call your attention to a new bale of cotton which was packed by a two-horse press by a concern in St. Albans, Vt., — The International Hay and Cotton Press Company. They can carry the size of the bale up to at least three hundred, and perhaps four hundred, pounds, and they can reach as great a

density as thirty or thirty-five pounds. The beginning, as you see, is going on in many directions, and the concentration of all these methods of improvement is the thing I wish to compass, and I therefore present this resolution.

Mr. PRAY. I have been over this ground without any consultation with Mr. Atkinson or his friends. We have not as yet compared notes for one moment, but I should urge the matter by all means; and, if a committee is appointed, I should like to have that committee make an appointment with me, and go to my house, and see what I have been up to for the last six months, and see if there is not ample need of making a move in this matter.

The motion was then adopted.

Mr. ATKINSON. During the noon intermission there will be hung up two more pictures from China, representing the cotton fabrication of China "From the Field to the Loom." By that method the largest body of cotton-using people in the world are now clothed. On that table presently will be a complete collection of the native garments which are used in North China, where it is very nearly as cold as it is here in winter. You will observe that for corpses very thin garments are assumed to be required by the Chinese, and for the dwellers in this upper world very substantial and thick ones.

The SECRETARY. I have been requested by Mr. Nagle of Providence, a member of the Association, to present an article which he has written on "The Loss of Power in the Use of Belts." It had not been passed upon by the Board of Government; and he desired me to request the Association to have this matter referred to the Board of Government, with leave to publish if they see fit.

A motion was made that the matter be referred to the Board of Government, with leave to publish with the report of this meeting, if they deem it advisable.

The motion was seconded and adopted.

The SECRETARY. The same gentleman, Mr. Nagle, has laid upon the table here a number of copies of a pamphlet, entitled "Formula and Tables for the Horse-Power of Leather Belts," for distribution among members who may desire to take them.

[Recess until two o'clock P.M.]

AFTERNOON SESSION.

The meeting was called to order shortly after two o'clock by Mr. [illegible] in the absence of the President, who stated that Mr. Atkinson had a few words to add in connection with the question of steam.

Mr. ATKINSON. Mr. Chairman, what I have to add would be in connection with the disuse of steam. Before I touch that subject, let me state that the set of water-color pictures painted upon these pieces of silk [which were suspended upon the wall] showing the Chinese work from the field to the loom upon each of its various stages, and this set of hand-made fabrics and garments of China, some of which are of most graceful shape, as you observe [exhibiting a mammoth pair of breeches], were contributed by Messrs. Russell & Co. of China, in answer to a request that they would purchase them for the Atlanta Exposition. They made me a present of this set for use at the Atlanta Exposition, and afterwards for the benefit of New England manufacturers, if they should find any service in them. They are some of the most perfect examples of the hand-made fabrics that I have ever seen of their kind, and will bear every [illegible].

[illegible] with the subject of heating, as many of you [illegible] investigated the question of electric light- [illegible] reached the conclusion that an electric [illegible] is the factory light of the future, for many [illegible]. The [illegible] question standing in the way of its general [illegible] the question of power. It interested me very greatly [illegible] at this meeting of scientific gentlemen, to have [illegible] Rogers, whose high authority you are all [illegible] attention to the progress which had been [illegible] the application of gaseous fuel to producing [illegible] thereby eliminating the wasteful inter- [illegible] of the steam-engine. The scientific statement of these [illegible] found in a lecture given by Professor Aryton of [illegible] delivered at the French electric exposition in French, [illegible] published and now for sale by A. Williams & Co. [illegible] School Street.

I [illegible] shall speak of this without any scientific knowledge, and without any indorsement of any kind, merely calling

your attention to a field which opens almost infinite possibilities. On examination I found that great progress had been made in the conversion of anthracite coal and superheated steam into a gas for heating purposes only. This fuel gas is not enriched as the water gas, commonly so called, is by the mixture of the gaseous products of petroleum; but is used pure and simple, burning with a blue flame, giving no light, but furnished through pipes for ordinary heating purposes and for the operation of gas-engines. This work is being done on a commercial scale, but at the same time experimentally only, on the part of a company of very rich men in New York who own the patents. It does not yet seem to have taken the form of stock certificates to any extent; and, as far as I can judge by visiting the works, they are genuine experiments by able men, taking time enough to eliminate faults to get at the true facts. This fuel gas, as they call it, is obtained by the burning of anthracite coal, first carrying the products of combustion through two superheaters until they are heated to a white heat. The direction of the draught is then changed; the steam, superheated, is carried into the fire-pot where the anthracite coal is burning, over the coal and not through it. At that point the current of superheated steam meets a shower, so to speak, of pulverized anthracite, constituting a third part of the quantity of fuel used, which of course is a very cheap element. That is oxidized immediately; all tendency to condense is removed; and a gas is produced at an alleged cost (I speak only by hearsay) of fifteen cents a thousand feet. It is alleged that this gas, in distinction from that now made in Europe by the Dowson process, has very much greater calorific power. The gas referred to by Professor Aryton, when worked in an Otto gas-engine, calls for the use of five thousand feet to get an equivalent of one thousand feet of ordinary illuminating coal gas. It is alleged by the parties in Yonkers that less than two thousand feet of their fuel gas is equal to one thousand feet of ordinary coal-gas. The gas-engine has been more fully developed in Europe than here. The only form of that engine which we have as yet much knowledge of is the Otto silent engine, which is now made in Philadelphia by a firm there whose name I do not recall. Mr. Woodbury has it. They are making some six hundred a year. The Clerk engine is a double-acting engine, and appears to have a more continuous action. The importance of the whole subject may be witnessed

by this fact: that Professor Aryton, who is a high authority, states that in gas-engines of small capacity — that is, of from fifteen to thirty horse-power — one horse-power per pound and two one-hundredths of coal per hour can be brought into use. The best result yet reached in practice in any steam-engine is in some of the more recent steamships built in Great Britain, in the best of the compound engines, in which they have obtained one horse-power to a pound and seven-tenths per hour. It will be observed that this allegation made by high scientific authority reaches results in a small gas-engine better than the largest and most perfect steam-engine ever reached.

Now, then, if fuel can be made from anthracite coal and water, distributed through the ordinary system of gas-pipes, and applied in gas-engines to the working of dynamo-electric machines, which was the connection in which Professor Aryton brought the subject up at the Paris Exposition, the question of cheap power for the production of electricity is on the way toward being solved. It will interest manufacturers, especially, who have gas-works, to find that a large portion of their works — to wit, the gas-holder and all the buildings — may be converted to useful purposes, first in the production of power with a dynamo-machine for lighting, but second, for domestic purposes and for manufacturing purposes; always qualifying what I say by stating that I have merely made one superficial inspection of the case, and being careful that that is put down, so that I may not be committed. It would appear that this fuel gas is being distributed through Yonkers to some two hundred takers.

I saw it in use in a little tailor's shop, where he heated his goose, and his goose served as his stove; he did not need any other heat in the shop. He did his smoothing and his heating with the same apparatus. I saw it in use in a milliner's shop, where the little German milliner was apparently a little proud of her coal fire burning in a stove with no dust and no ashes. The fuel was simply a lot of pieces of fire-bricks heated up to incandescence, and giving off heat and shining as if she had a good fire. In the hat-factory the same fuel is applied to the calender rolls, to straw-pressing, to embossing on the leather for the linings of the hats, and to a great variety of purposes. In the laundry it is applied to calender rolls and various other purposes which you know would be required in a laundry. It

is perfectly and absolutely under control. You can obtain a good degree of heat, and retain it uniformly for any length of time. It is also in use in two restaurants, the only heat that they have for cooking, and in many private houses. So far as a superficial and single examination can go, there is a great commercial fact already established. I understand that the works cost about forty thousand dollars. They allege that they make the gas at a cost not exceeding fifteen cents a thousand feet. They allege that they made fifty thousand cubic feet of gas from a ton of anthracite coal. They expect to reach fifty thousand or sixty thousand. They sell it at fifty cents a thousand. The consumers say that at fifty cents they get their modicum of heat at a cost less than the prime cost of coal for domestic purposes and shop purposes, and save all the necessity of removing ashes or coal, and all dust. It opens up a suggestive field which I should hardly dare to bring before the Association without further investigation, unless there was a scientific backing for the acceptation of the result. I think Mr. Grinnell knows something about the gas-engine; and Mr. Woodbury has lately investigated the works of the gas-engine company in Philadelphia. I think it would be an interesting subject, and at least worthy of calling your attention to.

Mr. GRINNELL. I can say a word to you in regard to the engines now being built in large numbers in Philadelphia, and I really take pleasure in doing so; not that I have any disposition to speak to you except to merely state what knowledge I have. I had occasion to establish a branch shop in Philadelphia for our works. In the first place, I had a suitable shop where I could get a suitable flue, and placed a small steam-engine to run the machine I proposed to put in the building. I also found it affected the fire insurance on a large building that I had control over. I presume it would be a new revelation to very many of the practical manufacturers in New England to learn that the gas-engine is so extensively used, and so very satisfactorily used. I saw one that had been running for four years, and was a smooth-running and pleasant piece of machinery; and, from a mere casual inspection of its working, I was satisfied it was a thoroughly practical, simple, and acceptable machine.

Mr. ATKINSON. I would like to add that this Otto engine is now largely used, operated by the ordinary illuminating gas which is distributed through pipes. The claim made by the promoters of the use of fuel gas is that there being no free carbon, no smoke, no liability to soot, they have an absolutely pure calorific agent which will not clog, and in the working of which the engine will keep itself perfectly clear and clean. The ordinary gas made from petroleum, such as we use in our factories, made in private works, cannot be used in the gas-engine at all, because it gives too much free carbon: it clogs. The ordinary illuminating gas of the city works, having much less carbon, can be used; but it would seem to be reasonable that a fuel gas with no free carbon at all might rightly be claimed as altogether the best for the purpose, and also, of course, excessively cheap. There is no purifying. The gas is carried directly from the gas-making apparatus right into the holder, then distributed directly for heating purposes. There seems to be nothing in the way of exceeding cheapness.

Mr. WOODBURY. Mr. President, those of you who desire to look up this question of fuel gas further can find a very exhaustive account of it in the transactions of the meeting of the mining engineers held at Washington; an article by the chemist, Professor Henry Wurtz of New York City, who has given a great deal of attention to this subject. Last Monday I was in the machine-shop of Schlier, Schumm, & Co., Philadelphia, where they build two hundred gas-engines a year; all less than twenty-five horse-power. They were in successful use there, and they are largely sold in the West. The question of the use of this gas is merely one applicable to small powers, where there is at the present time the greatest waste of fuel. In the use of coal gas, a horse-power is obtained in these gas-engines for about twenty-one cubic feet of illuminating coal-gas an hour; and with the fuel gas, such as is made in Yonkers, it would be about forty feet of gas per horse-power per hour. It is a subject that has, of course, a great deal of promise for the future, but it is limited to small powers.

The PRESIDENT stated that he did not remember the price paid at his mill, but a revision of the prices was being made; he thought the price was something like nine hundred dollars, but after the revision the price will be ten or fifteen per cent less than before.

M· .SON. There are three or four types of gas-engines to eference is made in England. The Clerk engine, a .cting engine, which has just been introduced into this .y, is made in Glasgow; and when I brought up the sub- of these small powers before the owners of the fuel gas in nnection with electro-motive power, it was apparently rather a new direction for them; and the next week I heard that they had contracted for one of the Clerk double gas-engines, and also for a dynamo-machine, and are about to set the two to work together in Yonkers, and develop the application to electric lighting.

I would call attention, also, to the sample of sliver which has been sent down from my office in that brown box, which is a representation of the product of the Clement attachment as I described, a hundred pounds a day of cotton properly prepared on a thirty-six-inch card. I would like to have experts compare it with the product of the Whitehead and Atherton card. I think it shows conclusively that the way to begin to card cotton is to begin to clean it in the seed.

The gentlemen will observe the graceful fashion of these garments, and also the fact that in North China, which is a very densely populated section of the world, they must use rather more than two and a half pounds of cotton to the head, which is the amount that has been assigned to them. If any one desires to appear in the habiliments of a Chinese corpse, the garments suited for that purpose are also here. If the Chinese use five pounds a head, they being probably four hundred millions in number, it would take two-thirds of an American crop of cotton to clothe the people of that country, of whom not more than five or eight per cent have yet been reached by the machine-made fabrics of Europe and America combined. Compared with the capacity of the Georgia home-spinners, the capacity of our own operatives in New England is one hundred-fold as much as the capacity of the hand-spinner and hand-weaver of the South. Assuming that the Chinese are twice as capable as the home-spinners of the Southern country, then these hand-made fabrics represent fifty times the amount of human labor that is represented by the fabrics made in our factories; and yet if you look at the cost price of these articles, which is given on the goods in cents based upon the Mexican dollar (that is, the one-

hundredth part of a Mexican dollar), you will see how very cheap they are.

The PRESIDENT. Gentlemen, there being no question before the body at the present time, any thing will be in order which any gentleman wishes to introduce.

Mr. PRAY. There is a proposition I would like to make. There are some men here to-day who are using the Garland atomizer, and there are other parties who are looking very anxiously in regard to using that apparatus in cotton-mills.

I would like to advance the suggestion that that thing be looked into, and somebody who is capable of doing it prepare a paper on it to be submitted at the next meeting. It has an important bearing on the subject of spinning. There are men here who are controlling large mills; and, if this information can be had, I think it will be desirable.

Mr. ATKINSON. Mr. Chairman, the question of the humidity of the atmosphere cannot be ignored. I believe there is a reason why there are eight millions of spindles in Oldham, England, rather than somewhere else. This town being situated just on the edge of moors where the condensation takes place, the humidity is always present. I do not believe cotton-spinning concentrates in that way without reason. I have felt an interest in the Garland atomizer. So far as I have been able to ascertain, the Garland atomizer has its use in preparing the atmosphere in a fine spinning-room. It has its function in preparing the atmosphere in the weaving of very high-sleid goods. It may fail in the loose-picked, low-sleid goods, for the singular reason that unless the atomizer is worked all night, or an hour or two before the mill is started in the morning, there will be so striking a difference between the humidity at the time the weaving starts and an hour and a half later, that low-count goods will come out irregular in width. It does its work, in a certain way, admirably: there can be no doubt of that. It is not, however, of universal application, and there may be other methods. A question was put to me by a fine spinner the other day, whether or not air, carried through water on its way to the room, might not be prepared and rendered humid. My reply was that I thought, if the air already containing a measure of humidity were carried through cold water, it might part with its humidity, or leave it behind in the water, and come out dryer than it went in; but I said, "Go to Professor Ordway, and find

." He sustained that view of the matter. He said, "You .n, by arranging in your basement a set of pans more or less .n area, and keeping the water in those pans at about the degree of temperature of the air that you pass over them, prepare your atmosphere on its way to the spinning or weaving room to any extent up to the point of saturation." I suppose that method is being tried. There are plenty of places in most basements where the open pans can be arranged and kept at a uniform degree of heat with steam-pipes, over which the air for the spinning-room or weaving-room could be carried on its way after it had been in some measure heated. That is a suggestion that is perhaps worth trying, as it will not cost a great deal.

Mr. PRAY made a diagram upon the blackboard of an apparatus by which the air could be conducted, accompanying his drawing with explanations of its practical apparatus.

Mr. ATKINSON called attention to a trial to be made the next day, in Chelsea, of Mr. Grinnell's new sprinkler. This trial is to be at Chelsea (the last one we shall have in our combustible building), at half-past twelve to-morrow. If any gentlemen would like to attend, they are welcome.

Mr. GRINNELL, being called upon, said, —

I would state that I did not come here expecting to say a word in regard to my own business; but it is a great satisfaction, on this anniversary of the day when I read my paper before the Association, to be able to state that the device which I then presented to the attention of the Association has met with such entire success in its operation. I felt an extremely chilly atmosphere, I assure you, when I read that paper before the Association. The idea, so to speak, of storing up water to extinguish fire in our mills, and liberating it by the action of heat which came from the fire, was a new departure, and may be as important as the telephone or electric light. It was then an unaccomplished action: it has been accomplished now, and has proved a success in thirty-two instances, putting out the fire by the action of its own heat. I have been engaged for years, and in fact the company has been engaged for the thirty years it has been in existence, in furnishing such fire-apparatus as has been called for by the manufacturers of New England; and I have tried to show parties interested, the property-owners, that they would be disappointed in the practical operation of the perforated sprinkler-pipe. There is, I

think, great merit and a great deal of hope in the introduction of the automatic sprinkler. It was through the assistance and appreciation of Mr. Atkinson that I was enabled to bring that matter before the Association, and the result has been largely satisfactory. There were two difficulties in the way of making a sensitive valve-sprinkler, but they have been overcome by a simple mechanical device; and the sprinkler which I now offer, Mr. Nagle, who is present, can state as an expert, after a long series of careful experiments made under repeated similar conditions, requires but from one-tenth to one-fifteenth the quantity of heat that other devices require. I believe I have a right to congratulate the manufacturers of New England, although it is a personal business matter of mine, that the thing has been accomplished; namely, a sprinkler so sensitive that it will work in far less time in a given temperature than those which have been introduced in the past, and which have accomplished a good share of success.

I thank you very much for this opportunity to speak a few words on this subject, although, I will say again, it was entirely unexpected on my part. I shall be glad to see any of the manufacturers present at the test, or exhibition as you might rather call it, to-morrow.

Mr. WOODBURY. In the absence of Mr. Thomas Wilmarth, who has been called away from the meeting by other duties, I wish to call attention on his behalf to the substitute for a wire thread guide which he has invented, and now uses in the mills under his supervision at Centredale and Dyerville.

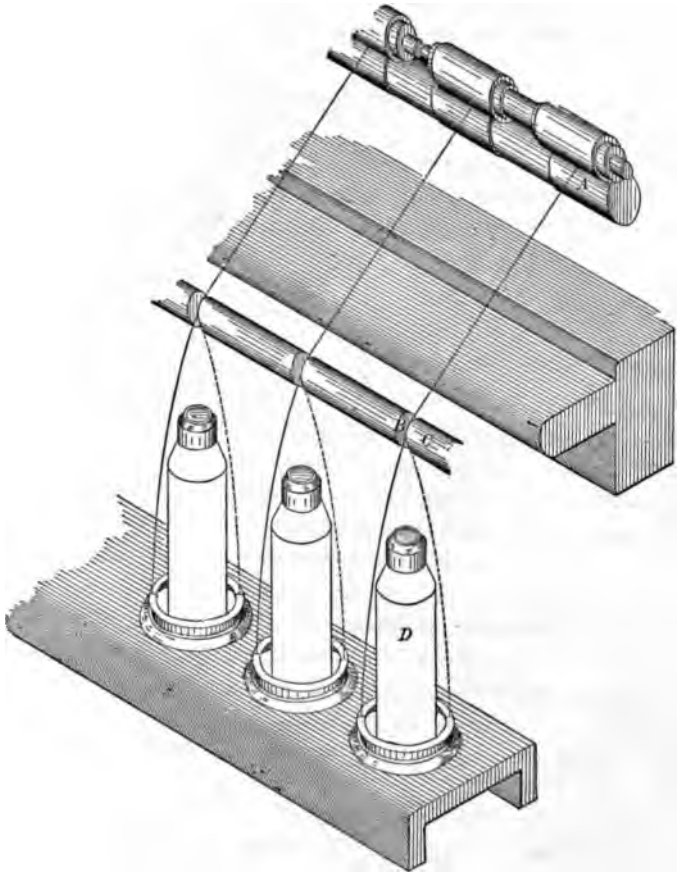
It consists of a roller extending the length of the frame, parallel to the front roll and partially over the spindles. It revolves with the same surface velocity as the front rolls, but in a contrary direction.

Scores are turned in this guide roll where the yarn passes over it; and at the front of the guide roll, the bottom of each groove is directly over the centre of a spindle. With spindles of the new Rabbeth pattern, when the guide roll is two and one-half inches above the top of the bobbin, there is sufficient clearance for doffing, as the bobbin can be drawn off at an angle after it is lifted slightly. For frames using other types of spindles, a smaller guide roll with whorls is used; for doffing, sufficient clearance is obtained by detaching a stop and sliding the guide roll in its bearings a short distance.

In its operation this device throws the twist to the bite of the front rolls, and relieves the yarn from excessive tension. The number of breakages is diminished, stretching is prevented, and therefore the yarn is stronger and more even, both as to number and twist.

In a frame spinning No. 30 yarn, with this attachment on one side, there were only three-fourths as many breakages as on the other side, where the ordinary guides were in use.

A general and informal conversation then ensued on the foregoing topics, illustrated by blackboard sketches, participated in by Messrs. Grinnell, Nagle, Atkinson, Woodbury, and one or two others; after which the meeting adjourned.



APPENDIX.

COTTON SAVING.

SUGGESTIONS TO MANUFACTURERS. — A WASTE OF THIRTY MILLION DOLLARS. — HOW THIS MAY BE REMEDIED WITH IMPROVED GINNING-HOUSES. — OPPORTUNITIES FOR NORTHERN CAPITAL.

By EDWARD ATKINSON, Esq.

Since the last meeting of the Association a very exhaustive investigation has been made to see whether the statement made by me as a reason for holding the Atlanta Cotton Exposition could be sustained or not. I alleged as the motive of that exposition that the cotton-crop of the United States was, on the average, depreciated at least one cent a pound by bad handling between the field and the factory. One cent a pound in a crop of six million bales is about thirty million dollars. On the whole, the representatives of the cotton manufacturers of New England, and the machinists who visited Atlanta and examined the subject in connection with the Exposition, or who have had previous knowledge in regard thereto, have more than sustained this statement of loss. Nearly every one consulted has added to this estimate his testimony that the labor expended in the present bad method of handling is twice or thrice as much as is needed; and that if the whole loss to the planters of the South from waste labor — waste in ginning, waste in baling, waste in transportation, waste in compressing, waste in the store itself by packing and stealage — and waste at every point — could be distinctly computed and tabulated, it would be nearer two cents a pound, or sixty million dollars a year. It is one thing to state this case, however, and quite another thing to find a remedy. With a view to possible remedy and to the probable profit on business investments in altering in some measure these conditions, two young gentlemen — one a graduate of Harvard College, son of an Alabama cotton-planter, the other a graduate of the Institute of Technology in the department of mechanical engineering — have devoted several weeks to the study of the present methods of

working cotton in Georgia and Alabama. From their report it is becoming apparent that the depreciation of the crop is becoming worse, and that little, if any thing, has yet been accomplished in remedying the defects.

GINNING ON A SMALL SCALE.

The process of ginning and baling in these States, which are, on the whole, two of the most progressive States of the South, is conducted by one of three methods: —

First, Ginneries run by horse or mule power.

Second, Ginneries run by steam.

Third, A very few run by water-power.

The latter may be disregarded. The principal part of the work is done in one of the two methods first named. Class 1 is the commonest of all, and is universally used where the farmer does the ginning for himself or for one or two neighbors. The gin-house is usually a two-story building of rough construction. The cotton is brought from the field in wagons, and carried to the upper story in baskets and by means of a ladder. Four mules furnish the motive power. The lint cotton is thrown by a brush into the lint-room, which is neither brushed nor swept from one season to another nor from one decade to another. What encouragement can there be for careful picking when the cotton is to be ginned in such a place? The press is the old "buzzard-wing" press. It stands about fifty feet from the gin-house, and the lint has to be carried this distance through wind and dirt and in all weathers. Most of the cotton is now left lying about wherever it may happen to be most convenient to place it after it has been pressed, exposed to rain and wind and other causes of injury. More crude devices for the manipulation of cotton, considering the importance of the work to be done, could not be found in India or in China. The stages through which ginneries of this class are passing toward improvement are interesting to note. The first thing done away with is the "buzzard-wing" press, for which an improved press is being established; the condenser attached to the gin makes the lint-room unnecessary; and when steam-power is applied, the old running gear is thrown away.

In the custom ginneries, operated by steam, the presses are almost always of an improved kind, of which there is a great variety. They are, however, mostly operated by hand and not by steam. The buildings are great improvements on the old plantation houses; the machinery is better, and more carefully attended to; and the facilities for handling the cotton are vastly superior to those of the old style. *But it is a matter of very grave doubt whether the cotton is turned out*

in any better condition than in the primitive way. In fact, there is every reason to fear that it is more injured in these establishments than in the old-fashioned way. During the ginning season these public ginneries are always crowded with work; each man desiring to have his cotton carried through immediately, and to return home; his chief object being to get the greatest quantity of cotton from the seed which he can possibly obtain. The proprietor of the gin is interested in getting through the largest number of bales; and he works with a view to accommodating his customers, and taking the largest toll, rather than with any idea of turning out good and uninjured staple which his customers do not appreciate. He runs his machinery at the highest possible speed, and works as closely as possible, in order to make a large yield of lint. If the truth were known, all "nepped" or overginned cotton could probably be traced to gins of this sort.

SIGNS OF IMPROVEMENT.

The more hopeful side of the question is to be found in the fact that a vast deal of information was spread abroad from the Atlanta Cotton Exposition; and the great margin of profit, which is to be measured by the depreciation of one or two cents a pound, is beginning to work its true results. For instance, in and around Hogansville, Ga., about two-thirds of the farmers are now planting selected seed, and are using all the means within their information to save it in good condition and to have it properly prepared. The representatives of large plantations upon the Mississippi River, where considerable investments by Northern men have been made, are making their arrangements to establish their own brand, upon which each grade of their cotton may be known and for which they will be responsible, so that it shall be as true to its title in either grade as the goods from any of your factories. The representatives of certain railroads, especially in Texas, have sought information as to the right methods of establishing public ginneries, to be equipped with sufficient capital to buy cotton in the seed (it being a more common custom in Texas than elsewhere to sell cotton in the seed), and also to establish their brand by which their cotton shall be known. The representatives of cotton-seed oil-mills are in many cases planning to attach cotton-gins to their works and to buy the cotton in the seed. This work must, however, proceed slowly, it is so little the custom outside of Texas to sell the cotton in the seed; and the lien laws, which subject the farmer and the planter to the corner shopkeeper, render it somewhat difficult to establish a fair practice of dealing in seed cotton. It appears that the business of ginning for toll gives an ample profit, and will presently lead to improvement as it becomes

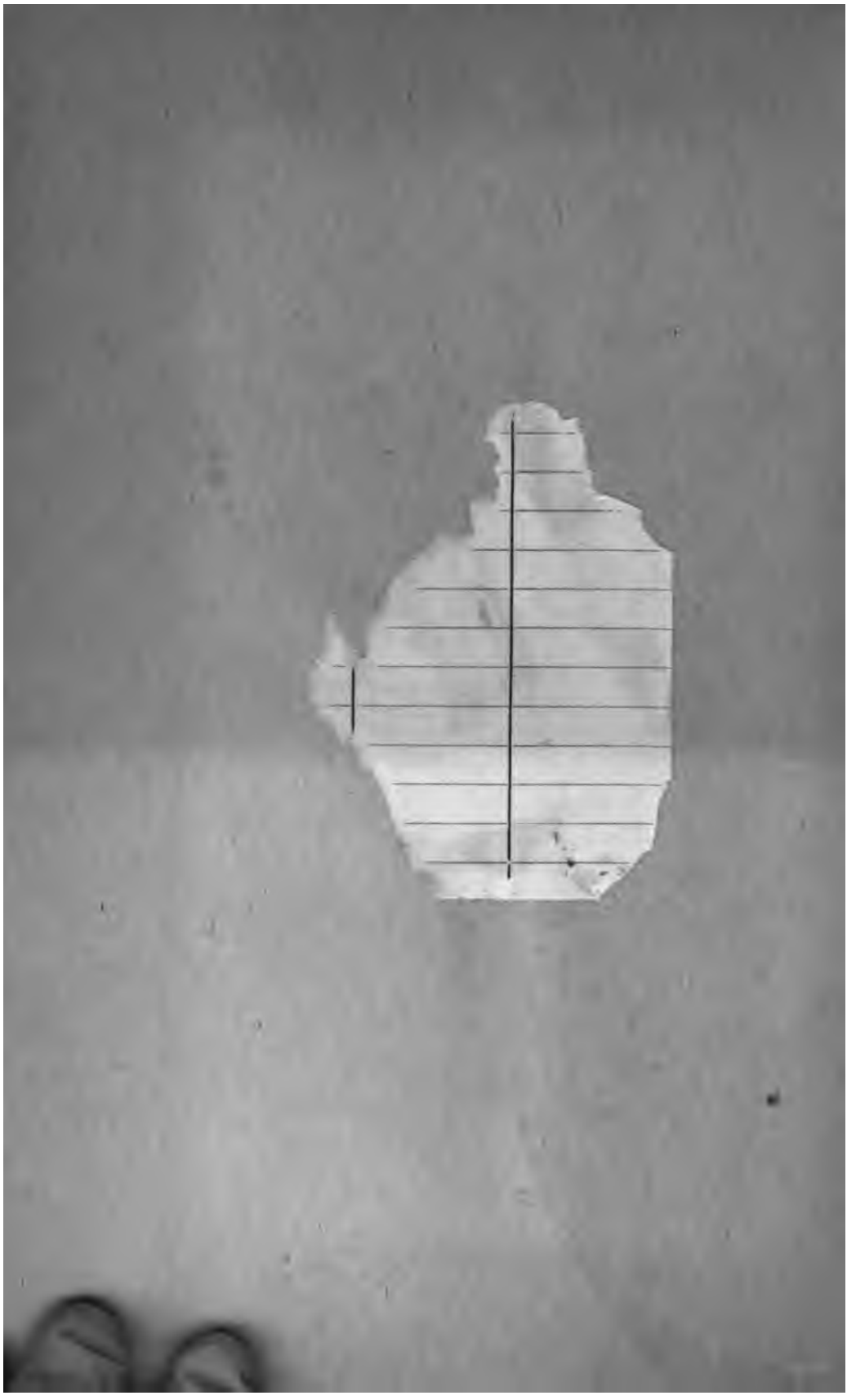
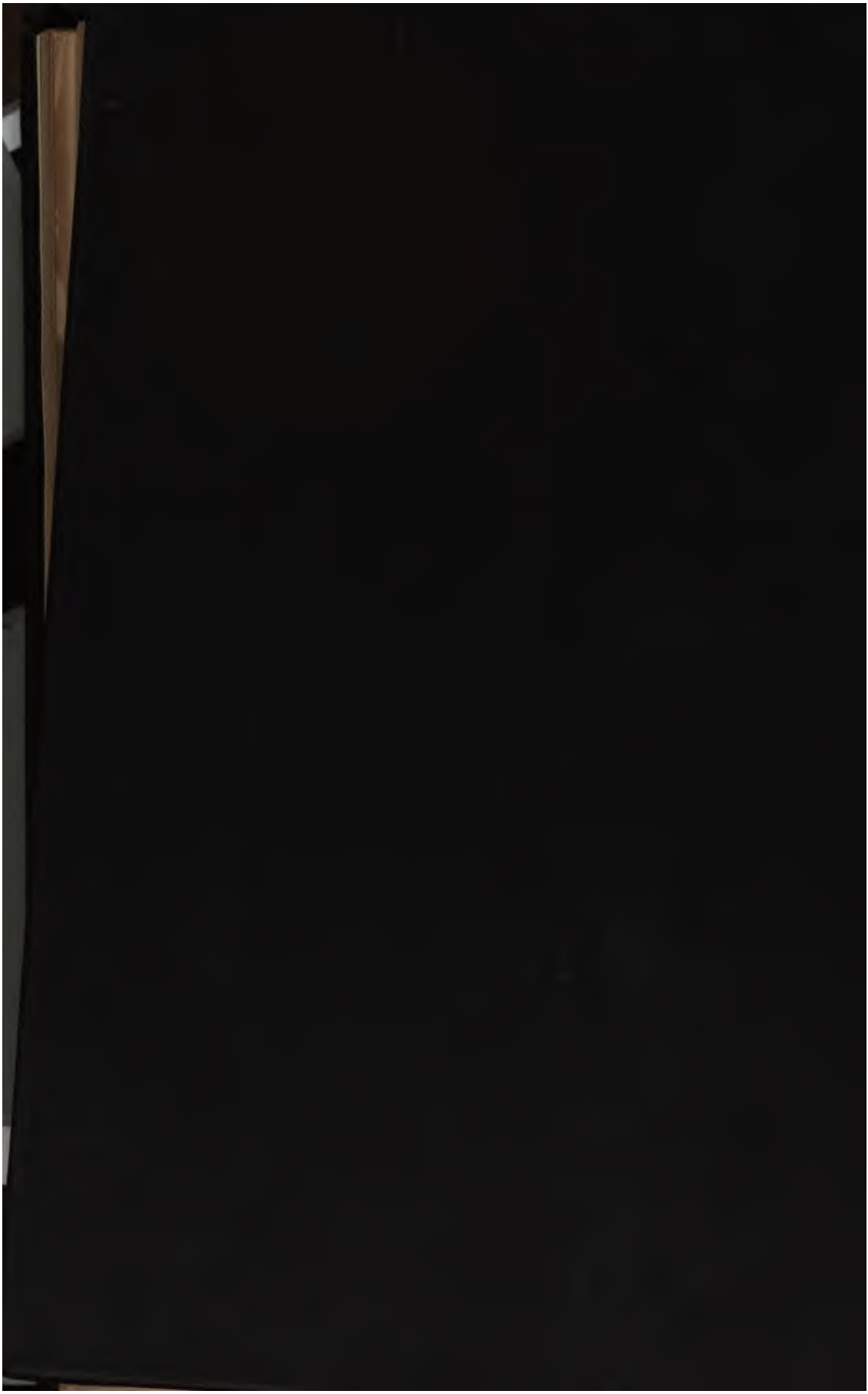
apparent that additional profit may be made by improving the condition of the cotton. A model cotton-ginning establishment, with a capacity for handling three thousand bales of cotton in a season of one hundred days, or thirty bales a day, can be constructed, with all the requisite buildings for the work and for storage, with three eighty-saw gins for common work and two roller gins for extra staple, suitable cleaners for cleaning dirty cotton in the seed, an exhaust blower to lift the cotton from the wagons and distribute it, a cotton-seed huller by which the hulls can be separated from the kernel, and all other requisite machinery, at a cost (with twenty-five per cent added for contingencies) of less than twelve thousand dollars. In such an establishment the purpose would be either to gin cotton for toll, or to buy cotton in the seed; to hull the seed, burning the hulls for fuel unless it was found that they were more valuable for other purposes; sending the kernels to the nearest oil-mill for the oil to be expressed, the cake to be returned to be ground at the gin-stand and distributed as cotton-seed meal, according to the demand. There would be one element of profit, now wasted, in such an establishment; to wit, the saving of what are technically termed "motes," being immature seed with much fibre attached. These motes constitute from one to four per cent of the weight of the cotton, and are most excellent paper stock.

A CHANCE FOR NORTHERN MEN.

I have never investigated any subject in which so large a profit appeared to be within reach on so small an investment as this; and there is certainly room for Northern men who desire to make a fresh start in a healthy upland country, among the Southern farmers, to benefit themselves while benefiting the neighborhood. It may be worth your while to observe how small an investment of capital would be required to treat the whole cotton-crop in a scientific and skilful way, provided only a true beginning can be made. I have said that a model establishment of the capacity of three thousand bales in the season would cost less than twelve thousand dollars. Two thousand such establishments scattered over the vast area of the cotton country — each treating three thousand bales in the season — would prepare six million bales of cotton, and would represent a capital of twenty-four million dollars. But even this amount is not necessary. Cotton in the seed can be kept, if properly stored, for an indefinite period without injury. If arrangements were made, and the custom introduced, for purchasing cotton in the seed, the ginning season might be extended to cover two hundred days instead of one hundred. The establishment named would then work six thousand bales in the season, and the capital required for the treatment of the whole crop

would represent only twelve million dollars. It seems almost absurd and visionary to say that by means of such an investment a saving of thirty million dollars in quantity, and of nearly thirty million dollars more in waste of labor and in other ways, might be saved: yet I think such is the only legitimate deduction from the facts disclosed at the Atlanta Exposition and by investigations since made. I can conceive of no branch of industry so likely to become very profitable as the organization of a large concern with five hundred thousand dollars capital, of which one-half might be invested in twenty model ginning establishments scattered through the upland country, in a healthy climate, among the progressive farmers, who only need the incentive of personal interest to be led in the right direction; the other half to be used as the working capital in purchasing and disposing of the cotton.

A COMING NECESSITY.

Whether or not such an undertaking shall be begun depends upon others, and not upon myself. My function in the matter has been to make a complete investigation and to report upon the facts. The facts will be submitted to the gentlemen at whose cost the recent investigation has been made, but who only contemplated a little work on their own account, being individual manufacturers, who did not contemplate this larger undertaking. I think the time may come within a short period when it will cease to be a matter of choice on the part of Northern manufacturers whether or not they will establish branches of their own factories to gin and prepare their own cotton. The present tendency to worse depreciation and to more bad cotton than has ever been seen will go on for several years longer. There is reason to suppose that the very sandy and falsely packed bales, of which we have heard so much in Consul Shaw's report and in other ways, are not to be attributed to any intentional fraud, or even to the adverse conditions of a bad season, but that they are the necessary result of the present method of treating the farmer's cotton which has been exposed for many weeks to the rain and mud. In general it may be said that the improvement of the cotton crop — except it be undertaken by special enterprise or by special methods indicated in this report — can only proceed with the general improvement in the conditions of society in the Southern States. How rapid or how slow that improvement may be, you can judge as well as myself. There are already very large planters with whom Northern manufacturers could, if they chose, enter into contracts for the delivery of cotton of a given quality prepared in any manner which they choose to pay for. On the other hand, the cultivation of cotton in Texas and in upland regions of the South is steadily working in the direc-

tion of small farms, in which cotton will be the surplus, or money, crop. This will be ginned in neighborhood gins; and the improvement in the quality will proceed in just the measure of the increase of intelligence and the means of communication between the farmer and the manufacturer. The ultimate contest for supremacy in the production of cotton will be between these two systems. My own judgment is that in the long-run the small farmer will lead, as he will subsist himself on other crops, and it will be difficult to say that his cotton costs one year more than another. It will be his surplus or profit, whatever it brings. Each of these processes will take a considerable period to work itself out; and in the mean time there is reason to expect consistent, regular, and increasing depreciation of the greater part of the cotton-crop. The very manner in which saw-gins are offered is a proof of this statement. The merits held out by the principal makers of the saw-gin are that an eighty-saw gin will work sixteen bales of cotton in a day, and will take all the lint off the seed; both of these recommendations being absolute faults. The utmost that any eighty-saw gin can properly work in a day, without injury to the staple, is ten bales; and the gin which is set so close as to remove the fluff or hair from the seed, as well as the true staple, is a mischievous and unfit machine. If the cotton States were exposed to a healthy competition elsewhere, and had not a practical monopoly, this tendency to depreciation would be speedily checked, or else the goose would be killed that lays the golden egg. Under the present direction it is difficult to see how the mills, which need good middling to fair cotton of even staple for fine work or for hosiery, can make sure of an even and regular supply unless they establish ginning departments of their own factories at suitable points in the Southern States.